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THE GRASSLANDS OF NEW ZEALAND.

GRASSES AND CLOVERS FOR HILL COUNTRY—*continued.*

E. BRUCE LEVY, Agrostologist, Biological Laboratory, Wellington.

(7) Danthonia pilosa.

"WHICH is the better grass—danthonia or brown-top?" This is a question often asked, and one that concerns the hill-country farmer most particularly. In my opinion these two grasses cannot well be compared; each is so characteristic of its own particular set of conditions that a fair comparison is extremely difficult. Brown-top under one set of environmental conditions is better than danthonia, but under another it is much inferior. Brown-top under brown-top conditions of soil-moisture, soil-fertility, &c., is better than danthonia growing on that same soil; but danthonia under its own conditions of soil moisture and fertility is better than brown-top growing under the same circumstances. The danthonia soil-type may be defined as a grade lower in quality and productiveness than the brown-top soil-type—dry, light lands of sunny aspect and low in available plant-foods (Figs. 119 and 120).

Danthonia is essentially a New-Zealander, and prior to the felling of the forest probably occupied a comparatively small space along the coast, where, by its binding and sward-forming capacity under poor and hard conditions, it healed over stabilized sand-dunes preparatory to scrub formation covering these areas. On the harder country, wherever breaks in the scrub communities occurred by slips or erosion or fire, we can imagine Danthonia pilosa spreading to the wound and healing the broken surface, preparing it once more for the scrub associations that follow as soon as the erosive effects of winds, rain, &c., are lessened by the sward of danthonia. Or in the South Island we can imagine breaks in the vast area of lowland tussock country becoming healed by this all-pervading pioneer which prepares the way for the ultimate climax formation of tussock grassland (Fig. 121), which, again, as it rises and becomes dense, smothers out its smaller, non-shade-enduring fellow-country species.*

In repeated burning of the tussock we see to-day the reverse taking place. The shade of the tussock is removed by fire, the crown

* Poa tussock may establish prior to a danthonia sward, using the mat plant scabweed as an establishment place for its seed.

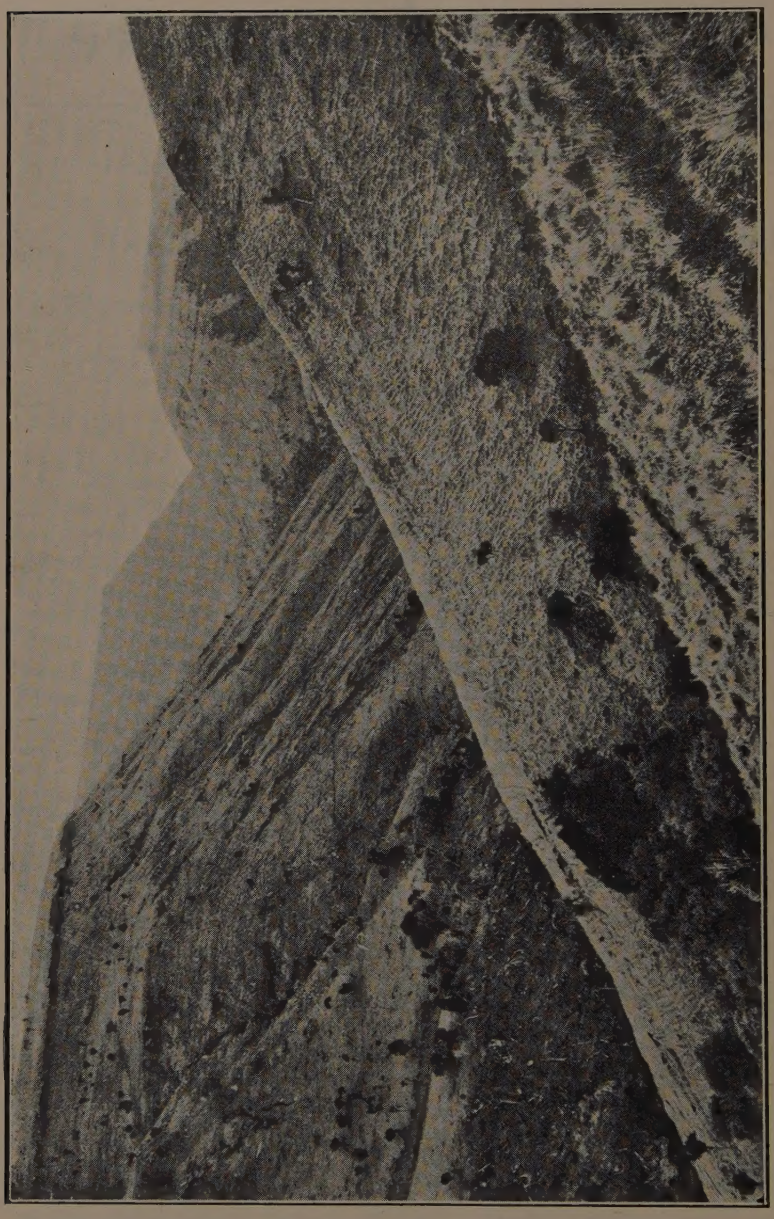

FIG. 119. COUNTRY ON WHICH DANTHONIA PILOSA IS DOMINANT.

Danthonia pilosa occupies a soil-type between brown-top on the one hand and Danthonia semiannularis, Grimmer grass, and bay-grass on the other. Hard, dry, friable, and unkindly soils, soils naturally low in available plant-food, or depleted soils characterize the danthonia habitat.

[*Photo by E. Bruce Levy.*

of this plant is damaged by heat and exposure, and wind plays havoc over the bared surface (Fig. 122). On this bared, wind-swept, sunlit surface Danthonia pilosa asserts itself, and begins once more its task of paving the way for the tussock advance (Fig. 123).

Danthonia is a pioneer that has been evolved by nature for New Zealand conditions to occupy barren areas, hard soils, dry soils, unkindly soils, and to prepare them for the advance of a higher class of vegetation. The clearing of the forest, the depletion of the fertility that that forest took ages to amass, the denuding of the humus layer of soil by repeated burning, and the constant outgo from the land of wool, beef, mutton, and butterfat have caused much of our country to revert to the original hard conditions, and danthonia has come in over millions of acres (Fig. 124). It has been reviled almost as much as brown-top, when all the time its presence is but a reflex of the original primitive hard conditions returning—conditions too hard for the forest immediately to reappear or for the high-yielding grassland species to thrive.

Danthonia-increase on the better-quality soils is in many places giving the lie to the claim of up-to-date methods where fertility maintenance of soils is the prime consideration. I unhesitatingly assert that increase of danthonia on the better country is a sure sign of insidious deterioration induced by poor farming, unscientific methods, and unfair methods such as drain the soil of its natural inheritance, the accumulation of ages. The incoming of danthonia is but a certain sign that henceforth the farmer can rely only on the natural plant-food resources of a primeval soil, unmellowed by years of humus accumulation or of detritus conveyed by flood and land-slide in the past. In natural New Zealand, Danthonia pilosa is virtually the lowest rung in the ladder of vegetation types. If conditions of soil and environment are such that this lowly type asserts itself, what opportunity or chance is there of getting high-production grassland species, such as rye-grass, cocksfoot, white clover, &c., to thrive? There is no chance until we artificially improve the conditions for such species.

This matter is purposely put very plainly here, for I feel the sooner the facts are realized by the farming community the quicker will we get down to bedrock as far as grassland improvement is concerned. The field for the improvement of the better-class soils that are running to danthonia is almost as great as that which lies in the elimination of brown-top by manuring, and the method of attack is much the same—namely, by use of the manure-bag, coupled with rotational grazing instead of close and continuous grazing.

DANTHONIA PILOSA AS A PIONEER.

There are great tracts of country in New Zealand clothed with vegetation types which are but a few degrees above danthonia in the ascending scale. Among these are tussock country, manuka country, cottonwood country, and even up to Southern beech (or "birch") and kamahi, which when destroyed and the humus they have accumulated and their ash have disappeared, leave the virgin surface that danthonia alone can permanently grass. Rye-grass, cocksfoot, crested dogstail, white clover, and even brown-top thrive only while working on the foods that the scrub and the forest have

FIG. 120. SHOWING DANTHONIA SOIL-TYPE WITHIN A GENERAL RYE-GRASS, COCKSFOOT, CRESTED DOGSTAIL, AND WHITE CLOVER SOIL-TYPE.

The hummocks shown in the photo are dry and infertile. These run dominantly to danthonia, while a sward of better grasses persists between, on the level and in the hollows, which aspects are not so dry and are more fertile.

FIG. 121. NATURAL POA-TUSSOCK GRASSLAND.

A soil-type that runs dominantly to Danthonia pilosa when ploughed, sown down to permanent pasture, and left unmanured for some years.

[*Photos by E. Bruce Levy.*

amassed, and when this is gone danthonia dominance or low-fertility weeds prevail, or stunted scrub once more asserts itself. In the grassing of such soils that cannot be ploughed the introduction and establishment of danthonia is of prime importance, so that it may act as a basic pioneer upon which to work for the ultimate improvement of the country. There are extensive tracts brought in out of scrub and other low-vegetation types where the carrying-capacity has improved rather than gone back since the clearing of the scrub. The pioneer danthonia is largely responsible for the improvement. In virtue of large areas of the holdings becoming danthonia-dominant more stock can be maintained, and this means larger camping-areas on the ridges or more level portions of the farm and a consequent improvement of these. More sheep are held, and at shearing and docking time small special paddocks are improved. All this is due to the fact that out-back on the run danthonia is faithfully playing its part, covering more and more bare ground, inhibiting the establishment and reappearance of scrub, piripiri, &c., and at the same time adding its quota of feed, meagre though this may be, on the harder faces. Along with the danthonia such clovers as suckling-clover, clustered clover, striated clover, &c., may thrive, and in the spring these help greatly with the milk-flow of wet stock.

Not only does danthonia induce more stock, but it acts as an excellent pioneer in another way. Danthonia country left to itself will not remain in danthonia for long; scrub of one sort or another or fern soon asserts itself. The prevention of such return is a fundamental problem of hill-country farming. Danthonia will carry a fire well, and there is no cheaper means available to the farmer for the destruction of young scrub or fern than the firestick (Fig. 125). The fire sweeps over the danthonia without doing it the slightest permanent injury, but destroys most young scrub, and clears off, temporarily at least, bracken-fern and hard-fern. The removal of the shade of the fern and scrub enables fresh tillering-out of the danthonia (Fig. 126), and affords opportunity for further establishment of shed seed, until ultimately so dense a turf is formed that further establishment of scrub and fern is prevented. The presence of danthonia over thousands of acres of North and South Island hill country at least has enabled such areas ultimately to be cleared by repeated firing. The same is true of tussock country; but whether the tussock is to be regarded as a form of secondary growth to be destroyed, or some value as shelter for the grass and herbage between, must for the time being remain an open question. The burning-off of the tussock, however, favours the spread of the danthonia (Fig. 123).

Danthonia is a mat-forming plant, and spreads vegetatively by means of its underground short tillering rootstock (Fig. 127). It is a non-shade endurer, and shade of any sort inhibits its outward spread from the rootstock or establishment from seed. Plants will linger, however, for quite a long time in moderately dense shade, and will come away strongly once the shade is removed. On the sunny aspect its spread is most rapid; burning and close and continuous grazing admit light readily to the crown, and these practices favour greatly its spread. Owing to the crown being well below ground, and in virtue of a deep rooting-system, it is a fairly good drought-resister, and

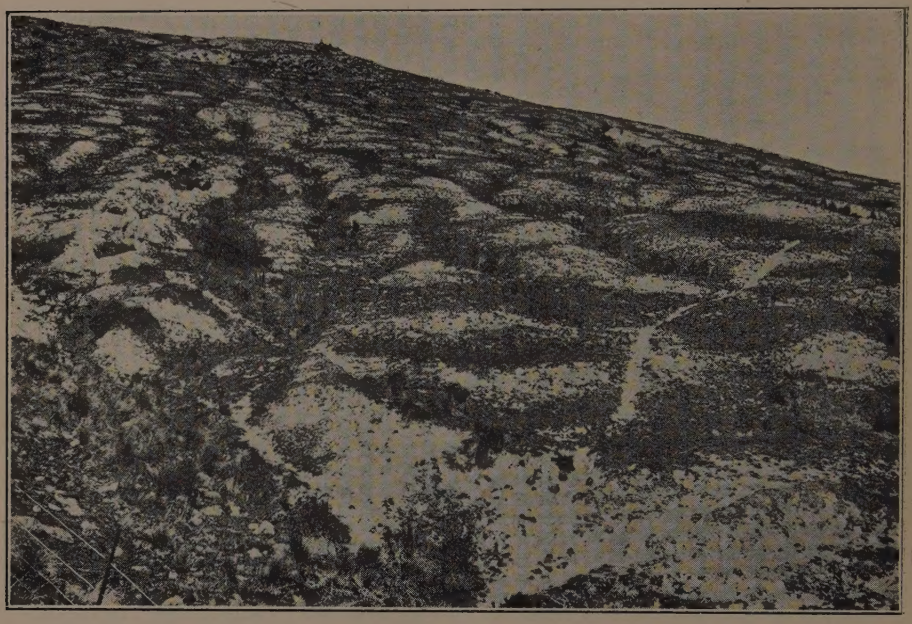

FIG. 122. TUSSOCK COUNTRY CLEARED BY REPEATED BURNING.

Here the conditions are such as to favour the establishment and spread of danthonia, and to hinder re-establishment of tussock.

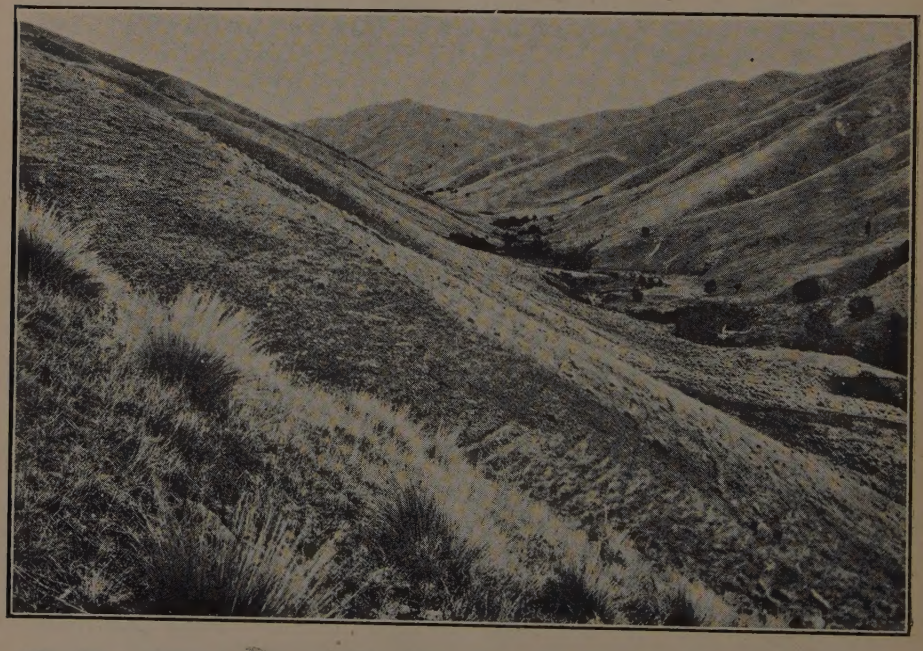

FIG. 123. TUSSOCK HILL COUNTRY WHERE THE TUSSOCK HAS BEEN DESTROYED BY REPEATED BURNING, AND RUNNING NOW TO DANTHONIA PILOSA DOMINANCE.

If the danthonia were left unburnt for some years poa tussock would begin to reassert itself.

[*Photos by E. Bruce Levy.*

FIG. 124. DANTHONIA PILOSA ADVANCE ON SOWN GRASSLAND.

Bush-burn country which originally held good rye-grass, cocksfoot, crested dogstail, poa pratensis, and white clover, showing these species being replaced by Danthonia pilosa. The white patches in the photo are danthonia. It will be noted that dominance of danthonia is first secured on the dry infertile knolls, and spread from here takes place as the soil-fertility becomes more and more depleted. Top-dressing such an area would stop the danthonia advance and confine it entirely to the poorer knolls.

FIG. 125. SECONDARY-GROWTH CONTROL BY FIRE ON DANTHONIA GRASSLAND.

Danthonia carries a fire perhaps better than any other grass. By means of it in a dry season a sweeping fire may be secured, and any young secondary growth may be checked or destroyed.

[*Photos by E. Bruce Levy.*

can spread vegetatively on exposed wind-swept and sun-baked slopes where ordinary pasture-plants rapidly succumb (Figs. 128 and 129). In addition to spreading vegetatively it establishes readily from seed shed on to the bare spaces, and this establishment under hard surface conditions from seed places danthonia in the fore rank of pioneers for the covering of such surfaces. On soils of low fertility where weeds of the catsear, rib-grass, cudweed type have already gained entrance to the pasture, danthonia once firmly established is able to replace these by virtue of its deep tillering-out, underground-stem system (Figs. 130 and 131). Moreover, such creeping, overground weeds as piripiri are gradually lifted off the ground and die out as the danthonia turf thickens up (Fig. 132). Control of most low-fertility-demanding weeds by a close and continuous turf is excellently well exemplified in danthonia.

The turf formed by danthonia, once all the ground is occupied, differs in many respects from the matted turfs that grasses such as brown-top or Chewings fescue make when these are growing under poor conditions outside their habitat range. The danthonia turf is sufficiently close and continuous to exclude most overground creeping weeds and rosette weeds of the catsear, dandelion, and rib-grass type, yet there is a certain openness, and upright annuals such as suckling-clover, hair-grass, &c., usually abound in danthonia pastures. This little openness is the life of the turf, and what has to be provided artifically by plough and disk and tripod harrows or hoof of cattle beast in the case of matted brown-top, Chewings fescue, paspalum, &c., is more or less naturally provided in danthonia—that is, aeration of the sward. This natural phenomenon illustrates one of the most important principles in grassland maintenance—that of soil-aeration. Air is as necessary to the life of the soil as it is to the aerial portions of the plant. Not only does it provide for the respiration of the subaerial parts of the plant and of soil micro-organisms, but there is a chemical action which leads to release of locked-up plant-foods present in all soils. To my mind it seems that each year by this natural ameliorating influence of air and sunshine there is sufficient plant-food unlocked to keep a danthonia turf thriving.

Danthonia-production, therefore, will represent the maximum growth possible on a soil when nature is unaided by man himself, and when the herbage that is annually produced is wholly absorbed by grazing stock and removed from the area concerned. Herbage allowed to accumulate on that area must in course of time lead to an increase there of available plant-foods. The principle of fertility-increase by spelling and converting the roughage produced into manure by the use of full-grown cattle beasts depends upon this fact (Fig. 133). Danthonia pastures, then, may be regarded as almost foolproof, and while production from such grassland may be low, the cost of production is also low. Danthonia is the cheapest grassland turf to maintain, and maintenance cost of any grassland sward is the deciding factor that must govern our choice of species for permanent-pasture work. Any soil can be made to grow high-production grasses and clovers—but at what cost? There is undoubtedly a point in grassland-farming where the maintenance cost of the better grasses and clovers is too high; in other words, there is much country—particularly hill country—where it does not pay to top-dress to the

FIG. 126. RENEWED GROWTH OF DANTHONIA FOLLOWING BRACKEN-FERN BURN.

Danthonia-plants recover rapidly after a burn, and shed danthonia-seeds readily germinate and establish on the bared surface. The light reaching to the crown of the plant stimulates fresh tillering.

FIG. 127. SHOWING TILLERING UNDERGROUND ROOTSTOCK OF DANTHONIA PILOSA.

The crown is underground and the new tillers arise from the end or from lateral shoots of the short tillering rootstock. Light encourages outward spread of the rootstock, but shade retards its development.

[*Photos by E. Bruce Levy.*

FIG. 128. DANTHONIA ESTABLISHING ON HARD, DRY, WIND-SWEPT FACE WHERE SUCH GRASSES AS COCKSFOOT UTTERLY FAIL.

FIG. 129. SHOWING SLOPE SIMILAR TO THAT IN FIG. 128 AT A FURTHER STAGE.
The danthonia is here joining up plant to plant to form a close and continuous turf.
[*Photos by E. Bruce Levy.*

standard required by the better grasses and clovers. Just where that line comes in is difficult of determination, but below that line Danthonia pilosa is the grass *par excellence*. It is essentially the grass for big acreages where it is wellnigh impossible to assist nature other than by reasonable grazing methods.

Although danthonia dominance over large tracts of country is here justified, and no other grass considered more desirable to secure, I must vigorously condemn the farming of danthonia on arable land or on land that can conveniently be top-dressed. As in the case of brown-top, the call to the grassland-farmer is to top-dress danthonia out, beginning first on the easy, readily accessible, and naturally more fertile areas, and gradually working back to the poor hillsides. The farmer himself will soon find out in this way where the economic line between the better grasses dominant and danthonia-dominant must be drawn. Phosphate response on danthonia-dominant turf is slow, even where the country is sufficiently moist to render available the more soluble of the phosphates (Fig. 134). From experiments conducted by the Department of Agriculture to date on danthonia turf in the Taranaki District it would appear that at least 10 cwt. per acre of phosphatic manure is necessary before there is any appreciable change in the composition of the pasture. Certainly the danthonia itself is rendered more palatable, owing no doubt to increase of mineral phosphate present in its herbage, and also from the fact that more young growth is produced. The production and utilization of young growth form, indeed, the crux of grassland management.

Dry soils, or soils with a long dry critical period in the yearly cycle, are more or less destined to become danthonia-dominant so far as truly permanent pastures are concerned, for there the farmer is powerless to conserve sufficient moisture to render consistently available even the most soluble phosphatic manures. On ploughable country the provision of annual crops is an essential characteristic of such districts, but where the plough cannot be used danthonia dominance is probably the only thing to meet the case. In the Hawke's Bay District there appear to be cycles of rye-grass subdominance in what is normally danthonia country. It is difficult to account for such unless on the assumption that during a dry season there is little outgo from the soil, and that there is going on continuously within it the aeration and amelioration mentioned earlier, so that actually an accumulation of plant-food takes place; thus as soon as good rains occur a sufficiently high fertility exists to stimulate the rye-grass persisting in the danthonia, and if only this state could continue rye-grass rather than danthonia would predominate. I feel certain that these better rye-grass and white clover seasons synchronize with some ameliorating influence that has been at work for some time previous to the renewed growth of the pasture, and it does seem hopeful, even on dry areas where it apparently does not pay to top-dress, that research will find a means of improving artificially the turf now danthonia-dominant.

FORMS AND STRAINS OF DANTHONIA.

There are apparently many forms of Danthonia pilosa, and this group would justify much close systematic work in order to develop the better strains. For the improvement of danthonia country, and for

FIG. 130. WEED-INFESTED PASTURE WHERE THE SOWN GRASSES HAVE FAILED AND WHERE DANTHONIA HAS NOT BEEN INTRODUCED.

FIG. 131. DANTHONIA INVASION OF WEED-INFESTED PASTURE.
On left of photo Danthonia pilosa has ousted most of the weeds, and is progressing forward on right
[*Photos by E. Bruce Levy.*

the good of great areas destined yet to carry a danthonia sward, work of selection, isolation, and propagation of the better strains should be undertaken. I am of opinion that the improvement of danthonia country lies not in the selection of a cocksfoot or a rye-grass to suit this hard soil-type, but it is the best danthonia that we require. Similarly for brown-top country it is the best brown-top that should be exploited, and so on with cocksfoot or rye-grass country. High permanent production, however, will not be accomplished, I feel, by the plant-breeder alone, but by the farmer who is prepared to feed the best strain that the plant-breeder can produce. The higher the powers of any grass to produce, the greater will be the need for adequate manuring. The normal danthonia-plant is a low producer; its inherent capacity to produce but little is the secret of its persistence on poor soils, and is its undoing on fertile soil, where it is asked to compete with strong-growing brown-top, cocksfoot, or rye-grass. It is only when the production of these latter species falls away to below the normal production of danthonia that this grass is able to gain and make headway in the turf (Fig. 135). Would that this fact could be instilled into the farming mind of this country! It would surely bestir the more progressive at least to keep a closer watch over their country, particularly those areas that have held good grasses for the last twenty years or more but which are now running to danthonia-dominant. All such country, I claim, could be manured back. It is for country that never held the better grasses for any length of time that I hesitate to assert the possibility of economically manuring out the danthonia.

DANTHONIA AND GRASS-GRUB.

In much the same way that danthonia has asserted itself over artificially sown grasslands, so, too, have certain native insects found congenial the precincts of sown grassland. Particularly is this the case with the grass-grub (*Odontria* spp.) and the subterranean caterpillar (*Porina* spp.), the adult woolly moth of which latter is so familiar at night-time about any artificial light. Certain grasses resist the attack of these two insects, but none so well as danthonia (Fig. 136), and one can well imagine how danthonia-spread is often indirectly facilitated by the ravages of these two grassland pests.

DANTHONIA UNDER SHADY AND SECONDARY GROWTH CONDITIONS.

Danthonia is a poor shade-endurer; quite a small amount of shade retards its vegetative spread and stops all establishment from seed. Nevertheless, danthonia lingers well within moderate shade, and its recovery once that shade is removed is an outstanding characteristic that fits this grass as a pioneer *par excellence* in the grassing of scrub and fern infested areas. Each burning lets in the light, which induces renewed and vigorous danthonia-growth from the old plants, and permits of germination and establishment of shed seed on the bared surface. Each burn, or each time the fern is crushed, encourages the spread of danthonia and weakens the secondary growth. The sunny faces are naturally the best lighted, and here we find the incoming and spread of danthonia most rapid. For the shady faces, where the illumination is comparatively poor, brown-top is better than

FIG. 132. DANTHONIA WINS AGAINST PIRIPIRI.

This photo was taken in one of the worst piripiri areas the writer has seen. Virtually the only places free of this weed were those where Danthonia pilosa had established itself. The dense turf formed by the danthonia forces the creeping overground stem of the piripiri off the ground, and this makes possible its control by cattle-stocking.

[*Photo by E. Bruce Levy.*

FIG. 133. DANTHONIA COUNTRY SPELLED (LEFT OF FENCE).

The spelling of danthonia country reacts in two ways: (1) By the shade the growth creates, the spread of danthonia itself is inhibited, while such grasses as cocksfoot and Poa pratensis are benefited; (2) by an accumulation of roughage, which later is converted largely into animal-manure per medium of full-grown cattle (not burned off), an actual increase in fertility is effected. Burning-off of such rank growth is justified only when control of secondary growth is the objective.

[*Photo by W. D. Reid.*

danthonia (see *Journal* for January last, page 12). The presence of danthonia among the scrub serves both to draw the stock and to carry the fire. Danthonia also retards the spread of hard-fern, particularly once the country ages, and its presence in a dry season ensures burning of hard-fern patches to the very edge.

DANTHONIA PILOSA ON THE PRIMARY BURN.

Danthonia is moderately slow to establish from seed, and no danthonia-plant at all will establish on the more fertile portions of the primary burn. Here rye-grass and cocksfoot exclude all possibility of danthonia-establishment, and just so long as these species last the need for danthonia is not felt. Those portions of the burn not so fertile (as pointed out in my January article) run to brown-top dominant, and on the very poorest spurs and knolls is found danthonia. It is also found in the weaker portions of the brown-top, becoming greener than the latter and spreading outwards as this species dwindles on the poorer aspects after three or four years. So remarkably true to aspect conditions do these species come to group themselves that one is apt to strain the credulity of readers who have not followed closely this matter for themselves. The better grasses thrive under one set of conditions, brown-top and Lotus major under another, and lastly, valiantly holding the extreme outpost of soil-types, is Danthonia pilosa. No hill country is so good that danthonia should not be included in the seed mixture of the primary burn. Its presence is the best insurance policy against ultimate deterioration that the farmer can take out for his farm. It will spread only when the conditions become too hard for the better species to thrive; it will fill up by reseeding any vacant spaces in the turf or which come to exist there, and will go a long way to prevent weeds of one sort and another gaining entrance. I have seen on quite new bush burns a complete sward of catsear, the outcome of non-inclusion of brown-top or danthonia; and again in large tracts of bush-burn hill country the only portions free of piripiri were those where danthonia had taken charge. Small as may seem the return from danthonia for the first two or three years on the primary bush burn, I would unhesitatingly recommend the inclusion of seed of this grass in the mixture. It is frequently asserted that there is no need to include danthonia, as it comes in naturally in later years. This, too, is true; but it is also true that many a bush-burn area has gone through a long period of weeds—piripiri, catsear, cudweed, hard-fern, &c.—before danthonia became introduced in this way An amount of 2 lb. to 3 lb. of Danthonia pilosa per acre should be included in all seed mixtures for primary forest burns.

DANTHONIA PILOSA ON THE SECONDARY BURN.

The secondary scrub or fern burn always presents more difficult conditions than does the primary burn; hence the need for the establishment of danthonia is still more pressing. There are in New Zealand large tracts of country which have had many secondary burns over them that to-day are danthonia-dominant grassland, and yet little or no danthonia has been sown. On secondary burns over areas adjacent to such danthonia-dominant country, or when burning areas where danthonia is already established, its sowing may not be necessary,

FIG. 134. TOP-DRESSING RESPONSE ON COUNTRY RUNNING TO DANTHONIA.

On this area, in the Whangamomona district, 6 cwt. of basic slag has been applied over a period of two years, and the soil-fertility is now approaching white-clover standard, as shown by this species coming back. On old danthonia country 10 cwt. or more of phosphatic manure is necessary to get much return of white clover.

FIG. 135. DANTHONIA PILOSA (ON RIGHT) AND COCKSFOOT (LEFT) ON LOW-FERTILITY SOIL.

The danthonia is here beating the cocksfoot in production, and consequently is able to gain in the sward. Photo taken in mid-February, when cocksfoot-growth should be at its peak.

[*Photos by E. Bruce Levy.*

as stock, particularly sheep, readily distribute the seed from one area to another, and weak plants within the scrub or fern strengthen rapidly once the shade is removed. It matters not how the seed comes to be sown on the secondary burn, whether by sheep or out of the seed-bag, the important thing to bear in mind is the need for the danthonia there. If the secondary burn is to be top-dressed, the danthonia will not spread in the face of superior vegetation; but as a safeguard, should top-dressing have to be abandoned, every care should be taken to ensure the establishment of danthonia. There are dry knolls where it will probably never pay to top-dress to the standard demanded by the higher-production species. These knolls should be in danthonia, else they become a breeding-ground for weeds. For all aspects too poor and too dry for brown-top, danthonia is essential.

CONCLUSIONS.

Danthonia pilosa occupies a soil-type between brown-top on the one hand and Danthonia semiannularis, Grimmer grass, and bay-grass on the other. In the soil-fertility scale it, as it were, occupies the second degree from the bottom. The Danthonia pilosa soil-type is entirely characteristic, presenting hard conditions, either from low moisture content or paucity of plant-foods. Where the limiting factor is moisture, danthonia may become dominant; but dominance on moist soils is almost certainly the reflex of low fertility—either naturally low or depleted by poor farming methods, such as close and continuous grazing over long periods and paying no attention towards making good the drain on the mineral resources of the soil. Danthonia dominance or spread in a pasture is a sure indication that conditions are too hard for the better grasses to thrive. It is not a question of danthonia ousting the sown English grasses, but of danthonia following up the retreat of the better sown species. Danthonia will not invade a high-producing turf of brown-top and Lotus major, or of crested dogstail, cocksfoot, rye-grass, and white clover. It is only when these are so reduced in vigour by being starved that danthonia can beat them in production. When this is the case danthonia will spread, but not otherwise.

Danthonia is a great pioneer on poor, hard soils—on stabilized sands, on manuka, stunted bracken-fern, cottonwood, poa-tussock, and beech and kamahi country. Here danthonia is about the only grass to be relied upon to hold permanently without top-dressing. In virtue of such aspects on the farm being covered with some sward of grass more stock can be kept, and this means the improvement of certain of the easier country in use as sheep-camps, holding-paddocks, &c. The rough danthonia also provides a certain amount of winter feed for cattle, and where scrub or fern is again putting in an appearance the danthonia, spelled for a growing season, readily carries a fire, excepting in certain of the wetter west coast districts. Through this attribute of danthonia many thousands of acres of hard hill country have been cleared of scrub and fern. The danthonia carries the fire, but itself is undamaged. The repeated firing of danthonia country, however, leads to almost pure danthonia, and prohibits the return of any of the better grasses such as cocksfoot and rye-grass. Spelling the danthonia hinders its own development from the crown, and

encourages greatly the return of Poa pratensis and cocksfoot. Then when these spelled areas are cleaned up in the winter by cattle the roughage is largely converted into quickly available manure, which encourages greatly the return of rye-grass.

Danthonia growing well is highly palatable when young, and on the moister and slightly more fertile portions it is found to be grazed equally with the rye-grass and white clover that may be persisting among it. On the harder knolls and steeper faces it is less palatable than on the slightly better aspects, owing to the smaller amount and less vigorous young growth produced. This original small difference

FIG. 136. GRASSLAND BARED BY GRASS-GRUB (ODONTRIA SPP.).

The dark patches are plants of Danthonia pilosa that have resisted the ravages of the grub. In foreground, hole 6 in. square from which twenty-one of the larvæ were taken.

[*Photo by E. Bruce Levy.*

in palatability, together with more difficult accessibility to stock, soon means a ranker growth and a consequent further reduction in palatability. Hence on certain knolls and harder faces danthonia may scarcely ever be eaten until the winter-time, and some farmers are apt to draw conclusions damning to danthonia, judging it solely on its behaviour on such aspects. The farmer is apt to consider the more palatable better-grazed portions as dominantly English grasses, whereas really danthonia is the dominant grass there also, but is kept young and palatable because well grazed.

As in the case of brown-top, danthonia may be manured out, but, generally speaking, it will take more manure to effect the same improvement in danthonia-dominant country than where brown-top is dominant. On soils brought in from manuka and stunted bracken-fern, cottonwood, poa tussock, and beech probably 10 cwt. or more of artificial manure will have to be applied before danthonia dominance

begins to wane. In such cases, however, the increase of palatability is very marked, ensuring a better and much more uniform grazing of the area. In those big blocks of country where rye-grass has held well for the last twenty years, but which are now running to danthonia, probably 3 cwt. of manure per acre will turn the tables against the danthonia advance. It is on this latter class of country that top-dressing is almost certain to pay handsomely right from the offset. In the case of the harder country it seems a case of spending some £3 an acre to get the country into a state where further top-dressing will pay. On the more difficult of such country danthonia is likely to remain the dominant grass.

Danthonia is a native of New Zealand, evolved to clothe its primitive soils. By its growth it prepares the way for the higher class of vegetation which replaces it. The removal of this vegetation by man and the depletion of the fertility which it has built up by its growth tend towards a repetition and renewal of the original primitive soil-surface, and nature again calls to her service Danthonia pilosa. The incoming of Danthonia pilosa, then, means that one is thrown back on to the primitive resources of the soil, and as such it is useless to expect anything higher-producing than danthonia to thrive. Danthonia may be taken, therefore, to represent the natural production of wide areas in New Zealand unaided by artificial manures or other practices that go to build up soil-fertility. Where these latter practices are impracticable the successful establishment of danthonia should be provided for as an insurance against weeds by sowing it on the primary and secondary burn, putting 2 lb. or 3 lb. per acre of good seed in the mixture sown for either class of burn.

(Series to be continued.)

STATISTICS OF FARM MACHINERY AND ENGINES.

FOLLOWING is a summary of farm machinery and engines employed on rural holdings (outside borough boundaries) in New Zealand for the past five years:—

Class of Machinery, &c.	1923.	1924.	1925.	1926.	1927.
Milking plants	13,553	14,553	15,561	16,391	17,090
Cream-separators	40,916	42,473	44,656	45,765	45,246
Shearing-machines—					
Plants	5,317	5,480	5,728	5,949	6,305
Stands	17,394	17,844	18,445	18,797	19,269
Wool-presses	8,179	8,035	8,601	8,641	8,832
Agricultural tractors	439	512	1,026	2,025	2,588
Reapers-and-binders	15,380	15,048	15,881	15,574	15,287
Threshing-machines	343	332	377	361	364
Chaffcutters	3,061	2,970	2,903	2,865	2,562
Water-wheels or motors ..	1,129	871	846	817	784
Electric motors	1,339	2,587	3,451	6,356	8,436
Steam-engines	709	626	622	473	435
Internal-combustion engines ..	18,209	18,864	19,894	19,584	18,885

—Census and Statistics Office.

IRON-STARVATION (BUSH SICKNESS) IN STOCK.

FARMERS' EXPERIENCE WITH ADVISED REMEDIES.

B. C. ASTON, F.N.Z.Inst., Chief Chemist, Department of Agriculture.

THE application of remedies the logical outcome of the adoption of the theory that "bush sickness" is really iron-starvation is in practical farming now beginning to show highly encouraging results. Previous published accounts of experiments have referred entirely to those conducted on either the Government Demonstration Farm at Mamaku or on leased areas under the supervision of departmental officers. The results outlined in this article are those conducted by practical farmers of repute who have carried out the work entirely by themselves, sometimes diverging from the official instructions and often varying the method of administration of the prescribed drug (iron-ammonium citrate) to suit themselves.

The area over which these farms are scattered is a very wide one, extending from the Bay of Plenty on the east coast to Putaruru in the Upper Waikato basin. The present statement of the position is made in general terms, often in the farmer's own words taken down on the farm itself by an expert officer of the Department, who therefore had an opportunity of applying something in the nature of a check. Only those farmers who had secured quantities of the iron remedies from the Department were visited. The fact of their continuous purchasing of the drug since January, 1927, may be held to be something of a proof that those who are using the iron scales are satisfied with the results obtained.

The article is thus not to be taken as a scientific record, but as an unbiased expression of opinion from practical men, and it is published in the hope of inducing other practical men to persevere with a remedy for a deficiency disease which is retarding the progress and holding up the settlement of extensive areas of country.

DISTRICT A (ABOUT 300 FT. ABOVE SEA-LEVEL).

Farmer "D," who has been using citrate of ammonium and iron scales for the past seven years with good results, has adopted the practice of putting a dessertspoonful of the scales into a 200-gallon drinking-trough from time to time. The water is, of course, being renewed intermittently, and the owner tests the requirement of the water for more iron by tasting it. When the iron-taste disappears another spoonful is added. All this farmer's calves are reared by the aid of the same drug.

Farmer "V," on the same road as Farmer "D," has had good results by dissolving the scales in the water-trough in a similar way to the method of his neighbour "D," and rears his calves by putting the scales into the feed milk.

DISTRICT B (ABOUT 1,000 FT.).

Farmer "E" has had good results in dosing cows with the solution of the iron scales.

Farmer "K," of same place, cured sick calves by dosing them with the iron scales.

Farmer "M" has had great results using a top-dressing of powdered sulphate of iron (hydrated ferrous sulphate) and superphosphate, and reckons that he "saved the situation" with his milking-cows by using that mixture. He also top-dresses with a basic slag and superphosphate mixture. This season he reared his calves on the top-dressed paddocks without dosing the calves with any iron medicine. He has bought quite a lot of sulphate of iron from the manure-merchants after his experience of a small parcel of the same compound provided by the Department of Agriculture.

DISTRICT C (ABOUT 1,000 FT.).

This district is reputed to be one of the most "bush-sick" areas in the affected region of the North Island.

Farmer "H," who has a farm with a bad reputation for the "skinnies," milks cows and rears his own calves, and is now getting as good a return as those of his neighbours who carry on by periodically changing their stock to healthy country. His system is to dose the whole herd for about three weeks every three months with the iron remedy. This treatment consumes 1 lb. of the citrate for each animal in the year, at a cost for the drug of 3s. 3d.; whereas by changing the stock it would cost him at least 2s. 6d. per week for two months in each year for every animal, involving an expenditure of £1 per annum for grazing fees alone. This method, besides the extra cost, has also the inconvenience and difficulty of working necessitated by the seasonal requirements of the animal. This farmer's stock (twenty cows and one bull) have, with the exception of two old cows, been reared on his farm under the medicinal method of treatment.

Farmer "D" and Farmer "F" also report satisfactory results from using iron and ammonium citrate scales. The latter farmer cures "bush-sick" animals with this medicine.

DISTRICT D (ABOUT 200 FT.).

Farmer "B" considers his land now quite healthy since top-dressing with phosphates and iron sulphate. He formerly used, but now has ceased to use, citrate of iron and ammonium medicinally.

Farmer "W," on the same road, uses the citrate with success as a medicine.

DISTRICT E (200 FT.).

Farmer "M" speaks highly of the effects of giving each of his cows 2 oz. of the solid scales per day for a period. He does not mind wasting some of the drug, as he says it "pays him to." He is a progressive, prosperous farmer, and the fact that since January, 1927, he has bought 126 lb. of the drug from the Stock Office is proof of the genuineness of his testimony. Such men are the pioneers of farming, unafraid to push new methods to the limit. However, one does not advise quite such heroic treatment to be attempted by others until more is known about the results of excessive dosage and the possible damage that the cows may suffer, especially when given at critical periods in the life of the cow. It is best to keep to the maximum official dose, which is 2 fluid ounces of a 6-per-cent. solution twice a day for each cow.

DISTRICT F (900 FT.).

Farmer "M" is a strong believer both in top-dressing with sulphate of iron and in dosing his cows and calves with iron-ammonium citrate. He has ceased to change his cows to healthier pasture since adopting the new treatment, and is now raising all his own calves. He is now one of the strongest supporters of the iron treatment both for soil and animal. He is a thoroughly practical and successful Scottish farmer.

DISTRICT G (ABOUT 500 FT.).

Coming to a district remote from the others mentioned, and where it was found that a large amount of the iron compound was being used, the largest user was interviewed. Farmer "V" stated that he was never able to rear his calves until this season, when he had done much better after using iron scales in the milk feed of the calves. Of these, seventeen out of twenty-two were thriving and in good condition. The remaining five calves scoured, but were picking up.

The Authoritative Methods.

It may be useful to again summarize the full authoritative method of coping with iron-starvation in stock. The following are the recommendations for farming-lands of the volcanic "soil-province" classified as sandy silts and gravelly sands of the Rotorua County (see maps published in the issues of the *Journal* for June, 1926, and August, 1927):—

(1) Farm more highly; get the plough in; compact the soil; grow plenty of winter feed; and save plenty of hay. Subdivide into smaller paddocks, and keep the pastures eaten short. Top-dress with phosphate—preferably containing iron or in conjunction with iron sulphate—as frequently as is the practice to top-dress in the Waikato. Treat the stock well, especially in the matter of water-supply.

(2) Use molasses freely in the feeding, especially in rearing young stock. Regard molasses as a preventive, but not as a cure.

(3) When an animal shows signs of going back in condition owing to iron-hunger, give double citrate of iron and ammonium as supplied by the Stock Inspectors at Rotorua and Tauranga at cost price to *bona fide* farmers. The dose for a cattle beast is 2 fluid ounces of a 6-per-cent. solution twice daily; 1 lb. of the scales may be dissolved in 13½ pints of water to make this solution. The medicine may be sprinkled on hay or other fodder for ease of administration. For younger animals the dose should be proportionately reduced.

(4) Buy any stock required from districts remote from the affected pumice land, and under conditions which ensure that the animals are free from disease or parasitic infection. Lack of the mineral elements is known to predispose an animal to other diseases and ailments, which, when introduced on to a farm on sick country, run a rapid course in the stock.

THE BLACK LOGANBERRY.

WITH reference to the warning published in the March issue of the *Journal* (page 203) concerning the so-called black loganberry, a leading Auckland nurseryman advises that he imported this variety some twenty years ago from California under the name of "mammoth blackberry," again five years ago from Australia as "black loganberry," and last year from England under the name of "lowberry." These plants were found to be identical and equally undesirable in characteristics.—*J. A. Campbell, Director, Horticulture Division.*

COMMON AILMENTS OF LIVE-STOCK AND THEIR TREATMENT.

(Continued.)

J. LYONS, M.R.C.V.S., Director of the Live-stock Division, Wellington.

Mammitis (Inflammation of the Udder).

THE damage wrought and the loss sustained by the ravages of mammitis throughout New Zealand amount in the aggregate to considerable proportions annually. It is doubtful, indeed, if any other disease present among our dairy herds is the cause of such extensive loss to farmers. However, owners of dairy herds in this country are not more unfortunate in this respect than dairymen in other parts of the world. The disease is known in every country where dairying is carried on; the loss and trouble caused thereby are world-wide.

Cause and Symptoms.—There are various organisms which give rise to mammitis, chief of which are those organisms belonging to the cocci group. These gain entrance into the lining tissues of the milk-gland and set up inflammation, which may vary in its intensity in accordance with the severity of the infection, the variety of infecting organism, or the resisting-powers of the affected animal.

In this country the disease is usually seen in what may be termed the subacute form, and may affect one or more quarters. Acute cases, however, are by no means uncommon. The accompanying inflammation is so slight at the outset of the disease that it cannot be recognized by either sight or touch, and the only indication that mammitis is present is a slight curd which can be seen if the first quart of milk from the affected quarter is examined. In many cases this is all that can be seen for the first few days. Gradually, however, the germs begin to multiply, and a greater number of milk-cells are implicated, until the effect of the inflammation can be felt or is visible to the naked eye, and the quantity of curd and matter in the milk has also increased.

In a quarter so affected, if the body-cells are not sufficiently active to destroy the organisms causing the disease and thus terminate its ravages, the organisms must attack the greater part of the secreting cells and destroy their function, thereby rendering the quarter useless. It is to be regretted that this is by far the most common ending when once a quarter becomes affected with mammitis. It is, however, by no means uncommon to see such cases recover spontaneously.

In acute cases the symptoms are more intensified, and are frequently accompanied by constitutional disturbances, in some cases to such an extent that the animal goes completely off its food. There is considerable heat, pain, and swelling in the parts affected, and the accompanying secretion is of a reddish-brown colour with a fœtid odour. In such cases it is seldom that the quarters affected return to normal. In fact, many such cases end fatally, owing to the reabsorption from the affected parts. Again, it is often found that abscesses have formed in the affected quarter. This is due to the organisms causing the disease gaining access to the interstitial tissues of the udder. In such cases the abscess should be opened when ready and free drainage allowed.

Prevention.—It has been demonstrated that mammitis is due to organisms, and if these can be prevented from gaining access to the animal-tissues our object is attained. In order to do so the dairyman's energy should be directed on ways and means to prevent the germ from gaining entrance to the system. To this end he should see that the dairy-shed and surroundings are kept as clean as possible. Diseased quarters should not be milked on to the floor of the shed, and should the material from an affected quarter escape by chance that part of the floor should be immediately cleaned and disinfected, otherwise portions of the material may be carried on to the pastures and become a source of infection to other cows. Milking-machines or the milker's hands should not be used on affected quarters and then brought in contact with healthy udders. For this reason it is necessary to see that all animals suffering from affected quarters are kept to the last, and milked by hand. The sound quarters should be milked first, and the affected afterwards. A bucket containing a quantity of antiseptic should be kept solely for this purpose, into which the affected material should be milked, and afterwards buried or destroyed. Even among the apparently healthy animals every care should be exercised to see that the machines are not placed upon affected quarters. Before being applied the attendant should draw a little of the first milk from each quarter into the hand, and if any clots are seen such an animal should be milked by hand for the time being, so as to prevent further risk of infection. In order that the chance of infection may at all times be reduced to a minimum it is necessary that the machines be kept scrupulously clean, as should also the hands of the milker.

Another feature in connection with the prevention of mammitis is the liability of the udder to become injured from various causes, such as overstocking (leaving the milk too long in the udder), and, what is even a still greater source of injury, running the machines at too high a pressure or keeping them working too long on the udder after the milk has been withdrawn. Under such conditions the udder-tissue is liable to become injured, and, owing to its enfeebled resisting-powers, is less able to withstand the invasions of the organism than if it had remained uninjured. For this reason the greatest care should be exercised to see that the milking-machines are always running at an even pressure, and not too high a pressure. Nor should they be left on after the milk has ceased to flow.

In giving these hints on preventive methods I fully realize the difficulty in carrying them out. The continual supervision of those in charge is required, and, in these days of restricted labour, care and tact need to be exercised. I feel satisfied, however, that were the instructions carried out in their entirety owners of herds would be fully compensated for their extra labour by (1) extending the usefulness of many of the individual members of the herd, and (2) by producing a better article.

In order to obviate the care and attention necessary to keep their herds as free as possible from mammitis many owners, both in this and other countries, have had the animals vaccinated, with a view to rendering them immune from an attack of the organism. The method of inoculation is a simple one, and had it proved successful a great boon would have been conferred on the dairy industry throughout

the world. It is to be regretted, however, that this method of prevention has so far failed to convey the desired immunity. Vaccines have also been tried as curative agents. Here again the results have not been satisfactory.

Treatment.—In treating mammitis it must be remembered that the disease is caused by an organism within the secreting tissues of the udder, and that it must be destroyed, either by the body-cells or by some other agent having germicidal action, before recovery can take place. For this purpose many medicinal agents, such as boracic acid, chinosol, &c., in solution, and ether and formalin in the form of spray, have been tried; but while in many cases a considerable degree of success has been attained it cannot be said that any of these methods of treatment give entire satisfaction. The method of treatment found to be most successful is good drainage. The udder should be stripped as frequently as possible, so as to clear away all debris and thus give the affected tissues every possible chance of recovery. Some American authorities claim highly satisfactory results from stripping out the udder every two hours night and day. Unless in the case of a very valuable animal, however, this practice is not likely to be carried out in New Zealand.

Prevention is what should be aimed at, however, and with this end in view, as already stated, too great care cannot be exercised in the way the herd is handled, and in keeping the surroundings and equipments of the shed in such a state of cleanliness as will reduce disease-carrying germs to a minimum.

Cow-pox (Variola vaccina).

This is a contagious disease characterized by an eruption on the surface of the udder and teats, which, if not interfered with, passes through several definite stages, and ultimately ends in a dark-coloured scab which falls off in about three weeks, leaving a pitted surface.

When once cow-pox makes its appearance in a herd it is liable to spread by the hands of the milkers from cow to cow, until the whole herd becomes affected. The management of such a herd is most unsatisfactory. The affected cows become upset while being milked, and this is liable to upset the others, and under the circumstances it is not uncommon to find the whole herd in a more or less excited state before the milking is finished. This is bound to have a diminishing effect on the milk-yield. Besides, there is always a danger of affected animals contracting mammitis through the affected material entering the teat-ducts.

Symptoms.—The eruption first makes its appearance as a small red papule. This in turn becomes a blister or vesicle containing fluid, which after a few days breaks and discharges pus or matter. Ultimately it dries up and forms a crust, which in due course drops off. A succession of papules may appear, and various stages of the disease may be seen on the udder at the same time. This, of course, prolongs the period of attack. As stated, if not interfered with the disease runs a definite course. This, however, is almost impossible when the vesicles appear on the teats. These are almost sure to be broken in the process of milking, with the result that slow-healing wounds appear.

Prevention.—As the disease is chiefly carried by the milking-machine or the hands of the milker, affected animals should be kept by themselves and milked by a special attendant, who should not be allowed to handle or milk the healthy animals of the herd.

Treatment.—Cow-pox being a disease which runs a definite course, little medical treatment is necessary. When the vesicles rupture, the parts should be kept clean and dressed with boracic or zinc ointment. Should it be necessary to milk affected animals with a teat-siphon, care should be taken to see that it is always boiled before being used.

Fistula of the Teat.

This trouble is generally the result of a barbed-wire cut. When the cow is in milk, before a fistula can form, the injury must extend to the teat-duct and allow the milk to escape through the opening made. Such a wound, owing to the milk continuously leaking through, ends in a fistula or opening in the teat. Any attempt made to close the opening when the cow is in milk is bound to end in failure. For this reason the operation should be delayed until the cow has gone dry. The edges of the opening can then be scarified with a pair of surgical scissors, and the scarified edges brought together by fine catgut sutures. The opening should be painted with iodine before and after the operation. If the opening is not too large a small stick of nitrate of silver may be used to cauterize it. The inflammation thus set up serves to unite the edges. When cauterizing it is necessary to see that the material is not too liberally used, otherwise the caustic may escape into the teat-duct and cause it to become obliterated.

Warts on the Teats.

It frequently happens that individual cows among a herd suffer from warts on the teats, which occasionally extend to the skin of the udder. These give considerable trouble when the animal is being milked. They can be removed without any great inconvenience to the cow, either by pulling them off or by clipping them at their junction with the skin with a pair of surgical scissors, after which the wounds should be painted with tincture of iodine. The operation should not be attempted when the animal is in milk. When the growths are small considerable benefit is derived from the application of castor oil after each milking

Milk Fever.

This important disease occurs in every country where dairying is carried on. In New Zealand it can be seen in almost every district during the calving season, although more common in some localities than in others. The symptoms are so well known as to require but little description, and yet the cause of the disease is still hidden in obscurity. The treatment is well known, however, and for this a debt of gratitude is owed to the Danish veterinarian Schmidt, who discovered a successful treatment some thirty years ago. This consisted primarily of pumping iodide of potassium into the udder; but within a few years the method was changed to inflation with air. Previous to Schmidt's discovery all sorts of therapeutic measures had been tried, and still the death-rate remained enormous. Since the discovery, however, the mortality has been reduced to such an extent that stockowners no longer look upon the malady as a serious one.

The disease pertains essentially to milch cows, and heavy milkers are more liable to become affected. It is met with more particularly after the third calving, although heavy milkers from the third to the fifth parturition period are also more liable to infection. It cannot be said that older or younger animals are free from the complaint, nor can it be said that the best-conditioned or the heaviest milkers are always the ones that become affected.

Symptoms.—These usually appear at any time up to three days after calving, but they are by no means confined to this period. Well-marked cases have been observed previous to parturition, while it is not uncommon to see typical cases weeks or months after calving. If the symptoms are observed from the outset the animal will be seen to paddle with the hind feet and stagger if forced to walk, the eyes become bloodshot and staring, with twitching of the eyelids, and vision is impaired or may be altogether lost. Finally the animal loses all control and falls down, and in some instances it may succeed in rising, only to fall again and ultimately become comatose. Occasionally a case is met with where the patient is delirious, struggles violently and bellows, dashes her head about, and is in a highly excited state. Such cases are far more difficult to treat, and the chances of recovery are not nearly so good as with the comatose or quiet state. It is seldom, however, that violent symptoms are observed. What the owner usually finds is the cow on the ground unable to get up. While on the ground she will be in one or other of two positions—(1) lying quietly on her sternum (breast-bone) with her head tucked into the flank; (2) lying flat on her side, in which position she will be struggling, with the stomach distended with gas.

Treatment.—This consists in stripping the udder clean of milk, rendering the teats aseptic by the application of tincture of iodine, and inflating the udder with air. After each inflation the teat should be tied with a soft rag to retain the air in the quarter; the animal should then be placed on her sternum and kept in this position. Recovery may be expected in from four to eight hours, according to the stage at which the treatment has been applied. If the treatment has been applied early the course of the disease will be greatly modified. In fact, by inflating the udder before the animal goes down the disease is cut short and a rapid recovery can be looked for. In a number of cases a relapse may occur. The animal, after recovery, in getting on to its feet goes down a second or even a third time, and all the symptoms return. However, I have seen several of these cases ultimately make a good recovery.

In treating milk fever, besides inflating the udder with air, it is essential that the animal should receive careful nursing, and that the attendant should refrain from the administration of medicine. If nursing is neglected the animal is liable to roll on to its side, in which case the stomach will become distended with gas, which will retard recovery or even cause the death of the animal. If drenches are administered there is a liability of the drench entering the windpipe, on account of the animal being unable to swallow. The liquid enters the lungs and sets up inflammation, which will ultimately prove fatal.

In all cases, when the animal has recovered, the air should be removed gradually. This is best accomplished by stripping the udder every few hours throughout the day.

(To be continued.)

CERTIFICATION OF SEED POTATOES.

OPERATION OF THE SYSTEM IN SEASON 1927–28.

J. W. HADFIELD, H.D.A., Agronomist, Department of Agriculture, Christchurch.

AN article dealing with the inauguration of seed-potato certification in Canterbury was published in the *Journal* for August, 1927, but before proceeding to the present review it may not be out of place to repeat the salient features of the scheme. The object of certification is to supply information that will enable merchants and growers to obtain seed that is true to name and reasonably free from tuber-borne diseases. Growers are asked to submit crops for inspection, and to forward with their application one hundred sets from the seed they intend planting. These samples are grown under uniform conditions where they can be watched carefully and the various lines compared with one another. During January the grower is visited and the crop carefully inspected. A second field inspection is undertaken just before digging, and a final tuber inspection is made when the seed is graded and ready for sale. Any grower who has a crop which passes the necessary standards in regard to purity and freedom from disease is issued with a certificate and sufficient certification-tags to enable him to attach one tag to each sack of potatoes he is selling.

The matter of grading for size is entirely between the vendor and purchaser, and has not been taken into consideration, although it may, at a later stage, be found desirable to standardize the grading as adopted in the inter-Island trade for table potatoes.

The Past Season's Operations.

Every one interested in potatoes will acknowledge that a great deal of confusion exists in regard to the naming of varieties. It is proposed to discuss this aspect of the question more fully in subsequent articles to be published in the *Journal*. In the meantime, however, it is necessary to make a brief statement on certain matters of importance to those who are interested in the seed-potato trade, and which have direct bearing upon certification.

NAMING OF VARIETIES.

As one of the objects of certification is to clear up the confusion in regard to varietal nomenclature, it is obviously undesirable to certify to a variety under more than one name, thereby suggesting that they are distinct varieties. Several varieties will now be discussed from this aspect.

(1) *Sutton's Supreme, Aucklander Tall-top, and Aucklander Short-top.*—It seems doubtful if the original Sutton's Supreme is grown commercially in New Zealand at the present time. It probably went out of favour in Canterbury shortly after the severe invasion of late blight in 1905, and it is not even procurable now from Messrs. Sutton and Sons, England, who raised the variety. Aucklander Short-top and Aucklander Tall-top are selections made from Sutton's Supreme about 1905. The tall-top variety is about three

FIG. 1. GENERAL VIEW OF THE DIFFERENT LINES OF UP-TO-DATE POTATOES UNDER TRIAL AT ASHBURTON EXPERIMENTAL FARM.

[*Photo by H. Drake.*

FIG. 2. LATER VIEW OF THE UP-TO-DATE POTATOES SHOWN IN FIG. 1.

Note the difference of maturity among the potatoes, due to the incidence of diseases.

[*Photo by A. W. Hudson.*

weeks later than the short-top, while the latter is probably six weeks later than Sutton's Supreme. Both the Aucklander varieties are sold in the North Island under the name of Sutton's Supreme, and to avoid confusion the tags issued in certifying these two varieties will be branded respectively—

Aucklander Tall-top (N.Z. Sutton's Supreme).
Aucklander Short-top (N.Z. Sutton's Supreme).

(2) *Dakota.*—Certification of Dakota crops has necessitated more discrimination than with any other variety. There is no great difficulty in identifying the Leader variety, which has a deep-yellow flesh, nor is it difficult to identify such varieties as Beauty of Hebron (pink), Early Rose, Scotia, and Russet Reading, when grown as pure lines. The Dakota, however, appears to have a wide range of variation (possibly due in some measure to virus diseases), and it has been extremely difficult to decide upon a limit of variation inside which a plant is termed a Dakota and outside which it must be deemed an impurity. A typical Dakota is easily recognized, and some very uniform crops have been inspected. In other crops the characteristics of the tuber shade off imperceptibly, and no doubt soil and climatic conditions materially affect the general appearance. The variety is of great commercial importance, and is the subject of special attention in the potato-selection work now in progress. It will be some years before these selected lines will be available, and in the meantime an attempt is being made to certify to the most uniform and disease-free crops.

(3) *Beauty of Hebron (pink) and Early Rose.*—These two varieties have, quite generally, been sold under whichever name appeared the most desirable. It is doubtful if any pure seed of Early Rose is available, yet they should be dealt with as distinct varieties, and it is hoped pure lines will be available within a few years. In the meantime the mixture will be certified to as "Early Rose - Beauty of Hebron (pink)" rather than eliminate the varieties from certification.

(4) *Beauty of Hebron (white) and Early Puritan.*—There is still confusion regarding these varieties, which, according to the most reliable information available, are identical. Beauty of Hebron (white), as grown in New Zealand, has a tuber flushed with rose, and will be the subject of comment in a subsequent article. All lines of Early Puritan sent in for certification were Bresee's Prolific, and as not one line of either variety has passed the necessary standard any pronouncement regarding nomenclature can conveniently be postponed.

(5) *Magnum Bonum and Bresee's Prolific.*—Nine lines of Bresee's Prolific and five of Magnum Bonum were entered for certification In all cases the Magnum Bonum lines proved to be Bresee's Prolific, and have been certified accordingly.

(6) *Northern Star and Gamekeeper.*—These two varieties have been so intermixed as to render it necessary to certify them as Northern Star - Gamekeeper. There exists considerable variation within the mixture, and selection work is being undertaken with a

FIG. 3. MAJESTIC AND IRON DUKE VARIETIES.

The centre row is the true Majestic variety. The adjoining rows in full flower are the Iron Duke variety commonly grown in parts of Canterbury and incorrectly named "Majestic."

[*Photo by H. Drake.*

FIG. 4. FARMERS INSPECTING THE CERTIFICATION POTATOES DURING A FIELD-DAY AT THE ASHBURTON EXPERIMENTAL FARM.

view to separating the varieties. One which has become popular under the name of Britain's Best is probably identical with Northern Star.

(7) *Majestic (Findlay's) and Iron Duke.*—Although the Majestic variety has not been included within the scope of certification this past season, a number of lines were sent in by growers, and it is intended to include the variety next season. For this reason it may be advisable to mention that the variety grown most commonly as Majestic—a strong-growing plant with large trusses of heliotrope flowers and round oval tubers—is in reality President or Iron Duke. The true Majestic (Findlay's) has somewhat spreading foliage, white flowers, and produces long oval (kidney) tubers, with shallow eyes. Both these varieties will be included within the scope of certification next season under the names "Majestic" and "Iron Duke" (the latter name being apparently better known than "President.")

ISSUE OF PROVISIONAL CERTIFICATES.

It has already been stated that certificates and certification tags are not to be issued till the graded seed has been inspected. This obviously places the grower and merchant in an unsatisfactory position, in that neither is able to come to terms regarding a line of seed until it is picked over, bagged, and ready for delivery. It has therefore been decided to issue provisional certificates, with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their produce.

The certificate states that the crop has passed all field inspections, but has not yet passed the final tuber inspection; further, that a certificate and certification tags will be issued later, provided an officer of the Department of Agriculture inspects the graded seed tubers and is satisfied that they are still of the standard in regard to purity and freedom from disease as was indicated by the previous field inspection. This certificate should go a long way towards facilitating business, and transactions should be made provisionally upon the seed passing the final tuber inspection.

The following growers have been issued with provisional certificates:—

		Area. Acres.
	Dakota.	
G. E. Benny	Southbridge R.M.D.	2
F. W. Carpenter	Prebbleton	19
J. Carr	Mount Hutt Rural, Methven	1
W. J. Crozier	Mount Hutt Rural, Rakaia	30
G. Hurst	Overdale P.O., Mitcham	4
W. McLachlan	Hills Road, Leeston	16
W. McPhail	Mitcham, Mount Hutt R.D., Rakaia	13
A. Paul	Highbank, Methven	3
W. Shellock	Mead Settlement, Rakaia	6
E. A. Smith	Broom Farm, Lincoln	25
C. E. Walker, jun.	West Melton R.M.D.	2
	Robin Adair.	
Muff Bros.	Orari, South Canterbury	4
L. T. Wright	Annat	2

		Area. Acres.
Early Regent.		
*W. Eder	Sefton R.M.D.	35
Bresee's Prolific.		
W. Barnes	199 Highstead Road, Papanui	7
J. Boag	Middlerigg, Brookside	2
D. H. Butcher	Broadfields R.M.D.	5
F. W. Carpenter	Prebbleton	30
J. Carr	Mount Hutt Rural, Rakaia	1
W. Chappell	Killinchy R.M.D.	5½
W. C. Lowery	Southbridge	18
D. Marshall	Killinchy R.M.D.	32
L. J. Palmer	Southbridge	4
G. H. Simpson	Templeton	1
Aucklander Short-top.		
F. Brundell	Camside, Kaiapoi	5
J. W. Ferguson	Kaiapoi R.M.D.	38
C. H. Jordan	Kaiapoi R.M.D.	4½
S. G. McCullough	Rangitira Valley, Temuka	3
W. E. Martin	Kaiapoi R.M.D.	9
A. J. Rich	Kaiapoi R.M.D.	10
R. Smith	Kaiapoi R.M.D.	5
Aucklander Tall-top.		
J. Bailey	Kaiapoi R.M.D.	6
Doak Bros.	Fernside, Rangiora R.M.D.	4
J. D. McMullan	Elmwood, Kaiapoi	8
H. S. Moore	Box 4, Kaiapoi	7
A. J. Rich	Kaiapoi R.M.D.	5
Epicure.		
R. Gray	St. Andrews	1
D. Marshall	Killinchy R.M.D.	6
Muff Bros.	Orari	1½
I. Robinson and Son	184 Cashel Street, Christchurch	3
W. Shellock	Mead Settlement, Rakaia	1
Arran Chief.		
A. Mortland	Templeton	10
F. A. Rollinson and Sons	Studholme Junction	20
*F. Saunders	Studholme Junction	4
J. W. Smith	203 Ilam Road, Fendalton	2
Northern Star - Gamekeeper.		
H. Watts	Willowby R.M.D.	35
Endurance.		
R. G. Bishop	Southbridge R.M.D.	1
Up-to-date.		
S. Cross	Courtenay R.M., Rolleston	3
C. E. Walker, jun.	Courtenay R.M., West Melton	6
F. Westaway	Courtenay R.M.D.	4

* Final certificate issued.

Extension of System in 1928-29.

The scheme, which has been confined to Canterbury during the past season, has met with considerable support, and applications have been received for extensions to other parts of the Dominion. Next season's operations will therefore cover Canterbury, Otago, and

Southland, and growers are invited to send in applications and obtain full particulars from the Department's Instructors in Agriculture in their respective districts.

Areas of 1 acre or more of any of the following varieties, if grown in Canterbury, Otago, and Southland, will be eligible for inspection during 1928–29 season :—

Arran Chief.
Aucklander Short-top (N.Z. Sutton's Supreme).
Aucklander Tall-top (N.Z. Sutton's Supreme).
Beauty of Hebron (pink).
Beauty of Hebron (N.Z. White Beauty of Hebron).
Black Kidney.
Bresee's Prolific.
British Queen.
Brownell's Beauty.
Dakota.
Duke of York.
Early Puritan.
Early Rose.
Early Regent.
Elephant.
Endurance.
Epicure.
Field-Marshal.
Gamekeeper - Northern Star.
Gold Coin.
Golden Wonder.
Great Scott.
Iron Duke (President).
Kerr's Pink.
King Edward.
Langworthy.
Magnum bonum.
Majestic (Findlay's).
Maori Chief.
Northern Star - Gamekeeper.
Perfection New Era.
Robin Adair.
Sharpe's Express.
Snowdrop (Witch Hill).
Up-to-date.

THE OFFICIAL SEED-TESTING STATION.

RECORD OF OPERATIONS FOR 1927.

N. R. Foy, Seed Analyst, Biological Laboratory, Wellington.

During the calendar year 1927 a total of 10,768 seed-samples were tested at the Agriculture Department's Seed-testing Station, representing an increase of 2,141 samples over the number dealt with for the preceding year. The aggregate was made up as shown in Table 1. The considerable increase may be attributed to the reduction in testing fees as from 1st April, 1927, this being evidenced by the fact that the extra business was almost wholly made up of commercial samples.

The number of samples received during each month for 1927 and 1926 is shown in Table 2; and Table 3 sets out the actual number of tests made and number of samples submitted for germination or purity or both. The number and percentage increases on the year's working are also shown, the purity tests leading in the latter respect.

Table 4 shows the number of samples received from the different land districts and the centres therein. It will be seen that with the exception of Auckland there has been an increase in all the main districts.

Table 5 gives the number of samples of the various species received for tests, and the number of tests—purity or germination—made on each individual species.

GRASSES.

The average percentage germination and purity of the main grass-seeds are given in Table 6. Compared with the figures for previous

Table 1.—Origin of Samples received and tested, 1927 and 1926.

Senders.	Number of Samples. 1927.	Number of Samples. 1926.	Increase or Decrease in 1927.
Seed-merchants	8,959	6,852	2,107 increase.
Farmers and seed-growers	233	399	166 decrease.
Government Departments	351	289	62 increase.
Laboratory tests	1,078	944	134 increase.
Retests	147	143	4 increase.
Totals	10,768	8,627	2,141 increase.

Table 2.—Number of Samples received in each Month, 1927 and 1926.

Month.	Number. 1927.	Number. 1926.	Month.	Number. 1927.	Number. 1926.
January	490	642	July	892	739
February	682	560	August	1,258	994
March	1,038	753	September	1,412	907
April	776	546	October	1,007	1,096
May	1,000	650	November	982	723
June	753	616	December	478	401

Table 3.—Classification and Numbers of Samples and Tests, 1927 and 1926.

Classification.	Number. 1927.	Number. 1926.	Increase in 1927. Number.	Increase in 1927. Per Cent.
Samples for germination only	7,641	6,731	910	14
Samples for germination and purity ..	2,868	1,785	1,083	60
Samples for purity only	259	111	148	133
Purity tests made	3,127	1,896	1,231	65
Germination tests made	10,509	8,516	1,993	23
Totals and general percentage ..	13,636	10,412	3,224	31

Table 4.—Number of Samples from the different Land Districts and Centres therein.

Land District.	1927.	1926.	Land District.	1927.	1926.
Southland	**3,377**	**1,979**	Auckland	**1,066**	**1,320**
Gore	1,493	..	City	900	..
Invercargill ..	1,774	..	District	166	..
District	110	..	Otago	**602**	**599**
Wellington	**2,323**	**1,900**	Dunedin	549	..
City	1,301	..	District	33	..
Palmerston North and Feilding	672	..	Marlborough ..	**228**	**129**
			Hawke's Bay ..	**213**	**228**
District	350	..	Taranaki	**129**	**59**
Canterbury	**1,680**	**1,142**	Gisborne	**47**	**9**
Christchurch ..	1,073	..	North Auckland ..	**24**	**3**
District	607	..	Nelson	**1**	**8**
			Westland	..	..

years, there is nothing calling for special note, except that the germination of rye-grass as a whole, as in 1926, was considerably depressed, only 9 per cent. of the samples germinating in the 90's and one-third in the 70's. This is due mainly to the lower average growth of Southern seed, which, as can be seen from Table 7, shows only 3 per cent. in the 90's.

The average purity and germination of the main grasses is shown according to place of origin in Table 7. Chewings fescue and crested dogstail show a high standard of quality in 1927, which was a particularly good year for these two seeds. The export demand for Chewings fescue was particularly good, the United States absorbing a record

Table 5.—Number of Samples of the various Species, 1927 and 1926, and Number of Tests made thereon, 1927.

Species.	1927.			1926.
	Germination Tests.	Purity Tests.	Samples.	Samples.
Lucerne	85	16	85	85
Alsike	54	13	54	69
White clover	387	246	444	333
Cow-grass and red clover	436	262	495	317
Crimson clover	24	7	24	23
Suckling-clover	30	23	30	11
English trefoil	34	10	34	31
Lotus major	55	28	58	83
Other clovers	88	19	88	73
Perennial rye-grass	2,713	849	2,748	1,744
Italian rye-grass	433	147	450	255
Western Wolths rye-grass	159	28	160	181
Timothy	86	35	86	88
Crested dogstail	1,163	515	1,187	768
Danthonia spp.	96	58	106	68
Brown-top	207	140	217	171
Chewings fescue	670	458	697	554
Meadow-fescue	33	8	33	29
Meadow-foxtail	21	4	21	39
Yorkshire fog	27	24	30	16
Cocksfoot	492	141	501	433
Paspalum	83	13	83	113
Poa pratensis	36	10	36	66
Prairie-grass	19	..	19	34
Other grasses	49	10	49	65
Japanese millet	14	..	14	32
Oats	29	1	29	31
Barley	74	2	74	27
Other cereals	8	..	8	23
Mangolds	201	31	201	171
Turnips	433	69	433	372
Swedes	292	44	292	288
Rape	153	6	153	115
Kale	115	3	115	75
Carrots	149	7	149	101
Forest-tree seeds	121	..	121	77
Flower-seeds	..	..	..	6
Vegetables (other than peas)	280	..	280	143
Peas	144	..	144	133
Tares, vetches, &c.	6	..	6	14
Grass and clover mixtures	16	17	25	21
Miscellaneous forages	23	..	23	18

Table 6.—Average Germination and Percentage of Extraneous Seeds for the Main Grasses, 1927.

The figures in parentheses in second column are 1926 averages.

Species.	Percentage of Germination.			Percentage of Samples germinating in Groups—						Average Percentage of Impurities.	
	Average.	Highest.	Lowest.	0–49.	50–59.	60–69.	70–79.	80–89.	90–100.	Commercial Seeds.	Weed-seeds.
Perennial rye-grass	75 (77)	100	11	2	8	16	33	32	9	1·1	0·4
Italian rye-grass	84 (87)	100	6	0	3	5	19	37	36	0·1	0·2
Western Wolths	82 (81)	99	16	2	2	6	21	35	34	0·2	0·3
Timothy	88 (91)	99	5	1	3	6	9	9	72	0·3	0·1
Crested dogstail	91 (84)	100	8	..	4	..	4	12	80	1·2	0·2
Cocksfoot	70 (69)	96	12	5	12	25	32	20	3	3·5	0·7
Brown-top*	85 (78)	99	4	3	4	6	11	20	56	0·7	0·8
Chewings fescue	86 (82)	100	0	..	5	..	9	16	70	1·0	0·4
Meadow-fescue	74 (63)	98	0	4	3	24	9	4	56	0·1	0·7
Poa pratensis	57 (48)	94	31	36	20	22	11	8	3	5·2	0·8
				0–19.	20–29.	30–39.	40–49.	50–59.	60–100.		
Meadow-foxtail	18 (36)	39	0	60	20	20	0	0	0	1·8	3·3
Danthonia spp.	52 (46)	76	15	3	3	17	16	21	40	16·5	9·0
Paspalum	41 (38)	82	2	0	0	0	94	6	0	0·5	4·1

* Average percentage of pure seed, 84 per cent.

Table 7.—Average Germination and Purity of Perennial Rye-grass, Crested Dogstail, Cocksfoot, and Chewings Fescue, grouped according to Place of Origin, 1926 and 1927.

Origin.	Average Percentage of Impurities.	Percentage of Samples germinating in Groups—								Average Germination.		Number of Samples.	
		Under 70.		70–79.		80–89.		90–100.					
		1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.
Perennial Rye-grass.													
Southern	1·5	36	29	30	36	29	32	5	3	74	74	963	1,737
Canterbury	1·1	12	18	22	25	37	35	29	22	83	80	363	441
Sandon	1·1	18	26	16	31	32	33	34	10	81	74	102	154
Hawke's Bay	0·8	3	18	4	7	14	38	79	37	93	83	95	100
Dominion	1·5	25	26	24	33	31	32	20	9	77	75	1,744	2,713
Crested Dogstail.													
Southern	1·3	11	2	11	4	24	12	54	82	87	92	563	987
Sandon	1·0	9	3	3	1	28	6	60	90	86	94	58	89
Dominion	1·4	15	4	11	4	24	12	50	80	84	91	768	1,163
Cocksfoot.													
Akaroa	3·6	83	73	15	23	2	4	0	0	62	63	75	127
Danish	1·9	21	16	43	38	34	44	2	2	76	76	126	124
Plains	9·3	15	41	40	31	34	17	11	11	79	71	35	54
Dominion	4·3	43	44	27	33	27	20	3	3	69	70	433	492
Chewings Fescue.													
Southern	1·4	10	5	10	9	38	16	42	70	82	86	554	670

quantity of seed. It would appear that both Chewings fescue and crested dogstail are being allowed more opportunity to thoroughly mature before harvesting, as, although shipment conditions are much the same now as they were several years ago, there have been no reports of the complete failure of consignments (particularly of fescue), which were so frequent at that time.

With the evidence at hand it is difficult to assign the low germination of most rye-grass to the factor of immaturity, although it is possible that with the increasing amount of top-dressing the plants are stronger in growth, and the seed is in consequence later in commencing and completing maturity. This statement is purely hypothetical, although it is freely stated in some districts that top-dressing is detrimental to the germination of the seed. Provided the seed is allowed to mature on the plant, there should be no detrimental after-effect from the application of artificial fertilizers.

In general, a high standard of purity was maintained in the samples. Cocksfoot, Poa pratensis, meadow-foxtail, paspalum, and danthonia were the only species wherein the average percentage of impurities exceeded 2 per cent., and only in the last three named did the weed-seed content exceed 1 per cent. The standard of purity for brown-top has been raised considerably, much of the seed received being over 96 per cent. pure, with an average over all samples of 85 per cent. In 1925 brown-top gave a pure-seed average of only 62 per cent. This higher standard of quality is due to the increasing production from Southland and Canterbury, in which districts the seed can be produced at a price which allows merchants to dress up to the full weight.

Noxious impurities: Californian thistle occurred in 5 per cent. of the rye-grass (1 per cent. Canterbury, 4 per cent. Southern), in 33 per cent. of the dogstail, in 2 per cent. of the Chewings fescue, and in 3 per cent. of the brown-top. Ox-eye daisy occurred in 4 per cent. of the Danish cocksfoot and 1 per cent. of the brown-top, in which latter were also noted a few seeds of dodder and ragwort. The occurrence of the seeds of ox-eye daisy, field foxtail, chamomile, and mayweed in several samples of Akaroa cocksfoot furnished conclusive evidence of the practice of blending Akaroa seed with Danish, of which latter seed the impurities specified are indicators. This blending has been noticed for several years past, but it was much more in evidence in 1927. Likewise, two samples of lucerne containing impurities foreign to Marlborough seed were submitted as Marlborough seed. Under the terms of the new Seeds Importation Act, which came into force last month, 1 per cent. of all imported cocksfoot and lucerne seed must be coloured red, so that the practice of substituting or blending foreign and home-grown seed will be absolutely prevented.

CLOVERS AND RELATED SPECIES.

The average germination and purity of the main clovers and related species is shown in Table 8. With the exception of crimson clover and English trefoil, all the species dealt with in the year under review were of high quality as regards germination. Over 2 per cent. of impurities is shown in white clover, alsike, Lotus major, and suckling-

clover, but only in the last-named does the weed-seed content exceed 1 per cent.

Noxious impurities: Dodder occurred only in 1 per cent. of the cow-grass samples, in 1 per cent. of white clover, and in 10 per cent. of Lotus major. Californian thistle occurred in 1 per cent. of cow-grass and white clover samples, and in 10 per cent. of Lotus major —all in very small quantities. Alsike for the first time on record at this Station was free from Californian thistle.

Table 8.—Average Germination and Purity of the Main Clovers and Related Species, 1927.

Figures in parentheses in second column are 1926 averages.

Species.	Percentage of Germination.			Percentage of Samples germinated between				Seed Impurities.				Average Percentage of Hard Seeds.
								Number of Species.		Average Percentage.		
	Average.	Highest.	Lowest.	0–69.	70–79.	80–89.	90–100.	Commercial Seeds.	Weed-seeds.	Commercial Seeds.	Weed seeds.	
White clover ..	86 (89)	100	0	6	15	42	37	10	67	2·6	0·6	11·0
Alsike	82 (86)	97	18	9	9	49	33	11	21	2·8	0·5	7·6
Cow-grass ..	87 (90)	99	6	4	8	37	51	23	69	0·4	0·3	9·4
Lucerne ..	75 (83)	99	41	28	36	16	20	10	8	0·4	0·1	17·4
English trefoil ..	64 (77)	100	0	50	26	17	7	8	15	1·3	0·3	14·0
Crimson clover ..	77 (94)	100	59	29	13	37	21	6	16	0·1	0·3	0·0
Lotus major ..	70 (78)	99	10	52	15	11	22	15	33	4·5	0·9	25·0
Subterranean clover	88 (91)	99	46	5	0	52	43	3	3	0·1	0·1	11·5
Suckling-clover ..	60 (77)	89	28	67	0	17	16	18	39	18·2	1·4	39·0

White Clover and its Impurities.

Some attention has been focused lately on New Zealand white clover in Britain through attempts by dealers to substitute New Zealand seed for Kentish wild white. A study made by the British authorities showed that *Silene gallica* (catchfly) associated with *Anagallis arvensis* (scarlet pimpernel) were the most commonly occurring impurities in New Zealand white-clover seed, and they are thus used as the main indicators. In this connection the data shown in Table 9 were prepared at this Station, and are presented here for their value in demonstrating the constant degree of occurrence of the various impurities from year to year. The figures under the heading of "Indices of Constancy" are the number of samples in each 100 examined which contained the individual impurity. The column "Wild White" under 1927 refers only to samples definitely labelled "New Zealand Wild White," and these figures may be taken as being truly indicative for New Zealand white clover.

Table 9.—Impurities of Commercial Seeds of White Clover for 1925, 1926, and 1927, with Indices of Constancy.

Species.	Indices of Constancy.			
	1925.	1926.	1927.	
	All Samples.	All Samples.	All Samples.	N.Z. Wild White.
Commercial Seeds.				
Trifolium dubium (suckling-clover) ..	89	87	94	100
Trifolium hybridum (alsike)	87	77	84	83
Trifolium pratense (red clover) ..	62	76	65	59
Phleum pratense (timothy)	38	35	35	45
Holcus lanatus (Yorkshire fog) ..	23	20	28	13
Medicago lupulina (English trefoil) ..	21	34	26	20
Lolium spp. (rye-grass (kernels)) ..	15	17	28	32
Cynosurus cristatus (crested dogstail) ..	9	3	8	8
Agrostis spp.	6	4	4	3
Poa pratensis	6	8	6	3
Dactylis glomerata (cocksfoot) ..	4	2	..	1
Lotus major	4	6	2	4
Phalaris spp. (kernels)	..	..	1	2
Weed-seeds.				
Rumex acetosella (sorrel)	92	79	87	90
Plantago lanceolata (rib-grass) ..	66	79	75	69
Chenopodium albium (fat-hen) ..	52	39	47	41
Anagallis arvensis (scarlet pimpernel)	51	45	54	48
Silene gallica (catchfly)	31	26	34	31
Stellaria media (chickweed)	30	29	15	14
Vulgare prunella (selfheal)	24	18	11	13
Cerastium vulgatum (mouse-eared chick-weed)	23	20	18	4
Sisymbium officinale (hedge mustard) ..	20	15	16	3
Spergula arvensis (spurrey)	17	14	13	15
Trifolium arvense (haresfoot trefoil) ..	16	15	13	12
Plantago major (broad-leaved plantain)	10	14	4	3
Polygonum aviculare (wireweed) ..	8	2	1	3
Cuscuta trifolii (dodder)	8	6	1	3
Anthoxanthum odoratum (sweet vernal)	5	2	2	2
*Silene noctiflora (night-flowering catch-fly)	5	7	4	..
Rumex crispus (curled dock) ..	5	9	6	7
Sherardia arvensis (field madder) ..	5	12	13	3
*Crepis capillaris (hawkweed) ..	5	6	4	..
*Veronica buxbaumii (speedwell) ..	4	1	2	..
*Anthemis arvensis (chamomile) ..	2	4	1	..
*Geranium pusillum (small-flowered cranesbill)	2	10	2	..
*Myosotis arvensis (forget-me-not) ..	2	3	2	..
Trifolium glomeratum (clustered clover)	..	9	4	6
Atriplex sp. (orache)	2	2	5	3

* Indicators for imported seed.

ROOTS AND CRUCIFEROUS FORAGES.

The average germination figures for this class are shown in the following table:—

Table 10.—Average Germination of Roots and Cruciferous Forages, 1927.

Figures in parentheses in second column are 1926 averages.

Species.	Germination.			Percentage of Samples germinating between					
	Average.	Highest.	Lowest.	0–49.	50–59.	60–69.	70–79.	80–89.	90–100.
Turnips ..	83 (88)	106	7	3	3	9	15	34	36
Swedes ..	81 (83)	100	11	2	2	10	21	29	36
Rape ..	89 (87)	100	30	2	2	5	5	26	65
Kale ..	80 (82)	98	15	3	5	8	16	31	37
Chou moellier	76 (82)	97	47	2	14	29	9	29	21
Mangolds ..	83 (78)	94	39	3	10	15	21	42	9
Carrots ..	60 (65)	97	14	21	24	28	15	10	2

VEGETABLE-SEEDS.

Of the 280 samples of vegetable-seeds tested, 90 per cent. were up to standard quality, average germination percentages being as follows: Peas, 95; beans, 94; broccoli, 73; cauliflower, 73; cabbage, 76; celery, 60; cucumber, 94; leek, 62; onion, 72; lettuce, 95; marrow, 60; pumpkin, 88; parsnip, 58; radish, 81; spinach, 56; tomato, 88.

CEREALS AND MISCELLANEOUS FORAGES.

The average germination percentages of those seeds forwarded for testing were: Japanese millet, 81; barley, 91; oats, 93; rye-corn, 86; wheat, 91; tares, 70; maize, 87.

"Cheap" Pasture Mixtures.

Samples of a number of so-called cheap mixtures were received from farmers during the year for testing and examination. With few exceptions these were found to be very poor in quality and of an actual value much below the price asked. Outstanding examples are given in Table 11 (next page).

Mixture No. 1 costs 7d. per pound, is worth 3d., and could be replaced in first-grade seed, minus 3 per cent. weeds (18 species including 350 seeds of Californian thistle per pound), for approximately 8d. per pound.

Mixture No. 2 costs 5½d., is worth 2¾d., and could be replaced in first-grade seed, minus the weed-seeds, for approximately 7d. per pound.

Mixture No. 3 costs 1s., is worth 6d., and could be replaced for 11d. per pound. It contains dodder at the rate of 300 seeds per pound.

During the recent bush-burning season many tons of the above class of mixtures have been sown in the North Island. The mixtures themselves are quite good in appearance, and are in fact reasonably clean

for seconds, but the price in nearly every case is far in excess of the true value.

Table 11.—Examples of "Cheap" Pasture Mixtures.

Constituents.	Analysis of "Cheap" Mixture.				Same Mixture in First-quality Seed.	
	Percentage of Mixture.	Germination Percentage.	Value per Pound of each Constituent.	Value of each Constituent in 1 lb. of Mixture.	Cost of each Constituent in 1 lb. of Mixture.	Cost per Pound of each Constituent.
Pasture Mixture No. 1: Price, 7d. per Pound.						
			d.	d.	d.	
Rye-grass	60·0	49	2·6	1·56	2·70	4½d.
Cocksfoot	3·5	18	3·6	0·12	0·50	1s. 2d.
Crested dogstail	5·7	20	3·5	0·20	0·90	1s. 4d.
Chewings fescue	2·4	0	..	..	0·28	1s. 0d.
Cow-grass	14·0	15	2·7	0·37	2·24	1s. 4d.
White clover	4·6	67	11·3	0·51	0·74	1s. 4d.
Suckling-clover	3·0	48	3·4	0·10	0·18	6d.
Other commercial seeds	3·0	..	0·3	0·09	0·30	10d.
Weed-seeds	3·0	..	..	..	..	..
Inert matter	0·8	..	..	..	..	..
Totals	..	..	..	2·95	7·84	..
Pasture Mixture No. 2: Price, 5½d. per Pound.						
Rye-grass	69·0	54	2·8	1·93	3·10	4½d.
Crested dogstail	3·4	20	3·5	0·12	0·54	1s. 4d.
Cocksfoot	2·0	21	2·8	0·08	0·28	1s. 2d.
Cow-grass	12·4	13	2·3	0·28	2·00	1s. 4d.
White clover	1·8	66	11·1	0·20	0·28	1s. 4d.
Other commercial seeds	4·8	..	0·5	0·02	0·48	10d.
Weed-seeds	4·6	..	..	..	..	..
Inert matter	2·0	..	..	..	..	..
Totals	..	..	..	2·63	6·68	..
Clover Mixture: Price, 1s. per Pound.						
Cow-grass	35·0	32	5·5	1·9	5·25	1s. 4d.
White clover	25·5	57	9·6	2·5	3·62	1s. 4d.
Suckling-clover	20·5	62	4·5	0·9	0·82	6d.
English trefoil	11·2	54	4·8	0·5	0·90	8d.
Other commercial seeds	0·8	..	0·3	0·1	0·30	10d.
Weed-seeds	4·0	..	..	..	..	..
Inert matter	3·0	..	..	..	..	..
Totals	..	..	..	5·8	10·8	..

Acknowledgment is made of the computation of the figures in this record by Mr. W. J. Cooch and Miss E. Green, of the Seed-station staff.

Meat Industry Research.—It is reported that negotiations are practically complete for the formation of a freezing companies' research association by the majority of the New Zealand companies. Useful information already has been collected from the United States and Britain as to the treatment of pelts.

WHEAT-MANURING EXPERIMENTS IN CANTERBURY, SEASON 1927-28.

A. W. HUDSON, B.Agr., B.Sc., Crop Experimentalist; R. A. CALDER, B.Agr., B.Sc., Instructor in Agriculture; and E. M. BATES, B.Sc., Assistant Instructor in Agriculture.

THE co-operative experiments on wheat-manuring conducted in Canterbury during the past season, while continuing certain of the objects of previous years, were designed to settle certain fundamental questions as a forerunner to systematic extension of problems depending upon the basic ones. Following are examples of these fundamental questions :—

(1) What is the best form of phosphate for wheat? Before work on the best-paying quantity of fertilizer is carried out this question must be settled. Obviously it is desirable to find out how much of an already determined best kind of phosphate to apply, rather than to attempt to ascertain what is the best quantity of a particular phosphate to apply without knowing whether it is the best kind or not.

(2) Does potash influence the yield? In the past, ½ cwt. of potash per acre has been used with, on the whole, no beneficial results. Is ½ cwt. per acre sufficient to enable this question to be answered? Certainly 1 cwt. per acre should give a decisive answer, and the larger quantity is now being used.

(3) Does nitrogen justify its use? Dried blood, a form of nitrogen recognized as not so efficient as forms such as nitrate of soda and sulphate of ammonia, has been used mostly in the past. Its paying use has been rather doubtful, while the other two forms of nitrogen have generally shown better results where used. Consequently the present work on nitrogen is being carried out with nitrate of soda at 1 cwt. per acre, a quantity considered sufficient to give a decisive answer as to whether nitrogen is of value or not.

If potash and nitrogen prove to be of paying use, the best quantity and—particularly in the case of nitrogen—the best time to apply are problems which will require solution.

Seven of the main wheat-growing counties—Eyre, Rangiora, Paparua, Malvern, Ashburton, Geraldine, and Waimate—were selected, and two experiments were conducted on a single farm in each district. The experiments are here designated "A" and "B," so that there was an A and a B experiment on each of the seven farms.

MANURIAL TREATMENTS USED.

These were as follows, the quantities given being at per-acre rate :—

Experiment A—

(1) No manure.	
(2) Superphosphate (44/46 per cent. tricalcic phosphate)	1 cwt.
(3) Basic super (41/43 per cent. tricalcic phosphate)	1 cwt.
(4) Ephos phosphate (guaranteed 54 per cent. tricalcic phosphate) ..	1 cwt.
(5) Nauru phosphate (about 80 per cent. tricalcic phosphate) ..	1 cwt.

Experiment B—

(1) Superphosphate	1 cwt.
(2) Superphosphate 1 cwt., plus muriate of potash 1 cwt.	2 cwt.
(3) Super 1 cwt., plus nitrate of soda 1 cwt.	2 cwt.
(4) Super 1 cwt., plus muriate of potash 1 cwt., plus nitrate of soda 1 cwt.	3 cwt.

The nitrate of soda was applied as a top-dressing in September. All treatments were replicated ten times, and each plot was divided into two or three at harvest, giving from twenty to thirty determinations of yield. (The method of doing this work is described in the *Journal* for July, 1926, p. 6.) Solid-straw Tuscan was the variety used in every case, except at R. Patrick's farm, Willowbridge.

NOTES ON TABLES.

All results have been submitted to statistical examination. The differences between the treatments and the control plots are shown in heavy type when these differences are "significant." If the differences are "non-significant," the letters "N.S." are inserted. A difference is said to be significant when the chances as shown by statistical examination are greater than 30 to 1 in its favour. Hence it can be said that a significant difference is one about which there can be no doubt. A non-significant difference, on the other hand, may be real enough, but it is too unreliable to be viewed with confidence.

In Tables A the no-manure plot is used as the control for comparative purposes. Where superphosphate gives a significantly better yield than the other phosphates the fact is mentioned in the comments on the tables.

In Tables B the superphosphate is used as the standard with which the other treatments are compared. As Experiments A and B were immediately alongside each other on each farm it is reasonable to suppose that the super in Experiment B would have given about the same increase over no-manure plots, had these been included, as it did in the adjoining experiment. Hence the net profit or loss shown by super in the A tables is carried down to the B tables, and forms the basis for comparison of return when potash and nitrogen are added to super.

In all tables net profit is estimated—on a basis of 5s. per bushel for wheat—as the increased monetary return after paying for manure at the following prices: Super, 5s. 9d. per cwt.; basic super, 5s. 3d.; Ephos phosphate, 6s. 6d.; Nauru phosphate, 5s. 6d.; muriate of potash, 16s.; nitrate of soda, 18s.

(1) Experiments on Farm of C. McIntosh, Horrelville (Eyre).

The paddock chosen had been in peas the previous season and in grass for two years before that. The plots were sown on 18th and 19th May, 1927, and harvested on 8th February, 1928.

During the growing-period August to October the superphosphate and basic super plots were slightly superior in growth to the remainder of the plots. Differences were most difficult to detect, with the exception of the plots on the B experiment, where the superphosphate drills showed up well ahead a few weeks after sowing. The potash and super mixture delayed germination, and depressed it to the extent of about 15 per cent. as compared with super alone. The nitrate of soda in the B experiment was applied on 26th September. The results are shown in Tables 1A and 1B.

Table 1A.

(Each yield is the average of 18 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) No manure	52·9	..	..
(2) Superphosphate	55·5	**2·6**	Profit, 7s. 3d.
(3) Basic super	55·7	**2·8**	Profit, 8s. 9d.
(4) Ephos phosphate	54·9	**2·0**	Profit, 3s. 6d.
(5) Nauru phosphate	53·9	**1·0**	Loss, 6d.

Comments on Table 1A: While the increases are small, they fully justify the use of three out of four of the manures.

Table 1B.

(Each yield is the average of 18 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	58·2	..	Profit, 7s. 3d. (see Table 1A).
(2) Super plus muriate of potash ..	57·4	N.S.	Loss, 8s. 9d.
(3) Super plus nitrate of soda ..	61·3	**3·1**	Profit, 4s. 9d.
(4) Super plus potash and nitrate of soda	61·8	**3·6**	Loss, 8s. 9d.

Comments on Table 1B: Super is reckoned to carry the profit, as shown in Table 1A. (The same procedure was adopted with other experiments, except No. 7.) The addition of potash to super has had no effect on yield, and the use of the mixture has resulted in a loss of 8s. 9d. per acre. Although nitrate of soda has given a substantial increase of just over 3 bushels per acre, this has not been sufficient to meet the cost of the dressing, and the profit is reduced to 4s. 9d. per acre. The superphosphate, potash, and nitrogen application shows a loss of 8s. 9d. per acre.

(2) Farm of Guy Bros., Fernside (Rangiora).

At Fernside a paddock having grown peas in the preceding season, and wheat, peas, and grass prior to that, was selected. The plots were sown on 26th and 27th May, 1927, and harvested on 30th January, 1928.

The superphosphate and basic super plots in Experiment A showed slightly better growth but lighter colour than the remainder. As will be seen from Table 2A, the growth appearance did not indicate the yield differences. Here again potash in combination with super markedly depressed early growth, and germination again suffered to the extent of 16·5 per cent. The nitrate of soda was applied on 19th September, and, in spite of an already vigorous dark-green crop, it increased

growth and deepened the colour to a noticeable extent within a month of application. The results are given in Tables 2A and 2B.

Table 2A.

(Each yield is the average of 11 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) No manure	60·2	..	..
(2) Superphosphate	60·6	N.S.	Loss, 5s. 9d.
(3) Basic super	59·5	N.S.	Loss, 5s. 3d.
(4) Ephos phosphate	59·2	N.S.	Loss, 6s. 6d.
(5) Nauru phosphate	60·0	N.S.	Loss, 5s. 6d.

Comments on Table 2A: None of the phosphates affected the yield to a significant extent. This was rather surprising in view of the growth differences in the early stages. The results do not appear to conform to the general experience on this land in other seasons, but certainly they are true enough for the paddock and season under review.

Table 2B.

(Each yield is the average of 15 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	62·4	..	Loss, 5s. 9d.
(2) Super plus potash	64·7	**2·3**	Loss, 10s. 3d.
(3) Super plus nitrate of soda ..	73·5	**11·1**	Profit, £1 1s. 9d.
(4) Super plus potash plus nitrate of soda	71·0	**8·6**	Profit, 3s. 3d.

Comments on Table 2B: The addition of potash to super has caused an increase in yield of 2·3 bushels per acre, which is not sufficient to pay for the costly application. The initial depressing effect of the potash on germination does not correspond with the effect on the yield. Nitrate of soda, which looked markedly superior before the harvest, has caused a very considerable and profitable increase of just over 11 bushels per acre, and a resultant profit of £1 1s. 9d. from the use of the phosphate and nitrate. Whether the nitrate applied to crops not already dressed with phosphate would have brought about such an increase is problematical. The complete fertilizer treatment does not show as good a yield as the treatment just mentioned, and the profit is only 3s. 3d. per acre.

(3) Farm of F. W. Carpenter, Prebbleton (Paparua).

The previous crop on the paddock selected was potatoes, and for four years prior to the potato crop the paddock was in grass. The plots were sown on 6th and 7th July, 1927, and harvested on

TYPICAL PLOTS ON CARPENTER'S FARM.

From left to right the pegs are marked—(1) No manure, (2) basic super, (3) super, (4) Ephos, (5) Nauru. Note superior growth of basic super and super plots. Photo taken about 29th September, at which stage nitrate of soda was applied to the adjoining Experiment B.

[*Photo by E. M. Bates.*

6th February, 1928. From 30th August onwards the super and basic super plots in Experiment A showed a marked superiority in growth (see photo). Plots receiving potash in Experiment B showed a definite though slight retardation in growth just after coming through the ground. Counts of plants showed no difference in the actual number of seeds germinating. Nitrate of soda was applied on 28th September, and its effect on colour and growth began to be apparent three weeks later. The yields are shown in Tables 3A and 3B.

Table 3A.

(Each yield is the average of 20 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) No manure	62·7	..	..
(2) Superphosphate	70·8	**8·1**	Profit, £1 14s. 9d.
(3) Basic super	69·3	**6·6**	Profit, £1 7s. 9d.
(4) Ephos phosphate	65·6	**2·9**	Profit, 8s.
(5) Nauru phosphate	66·5	**3·8**	Profit, 13s. 6d.

Comments on Table 3A: Superphosphate has given a very considerable increase of 8·1 bushels per acre, with a net profit of £1 14s. 9d. Although the other phosphates have paid, the superphosphate yield is significantly higher than all others.

Table 3B.

(Each yield is the average of 18 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	76·7	..	Profit, £1 14s. 9d.
(2) Super plus potash	72·4	— **4·3**	Loss, 2s. 9d.
(3) Super plus nitrate of soda ..	81·8	**5·1**	Profit, £2 2s. 3d.
(4) Super plus potash plus nitrate of soda	77·2	N.S.	Profit, 9d.

Comments on Table 3B: Potash has caused a definite and significant depression in yield. Treatment 2 is less than treatment 1 by over 4 bushels per acre, and treatment 4 is less than treatment 3 by about the same amount. The effect on the financial aspect is highly unsatisfactory. On the other hand, the use of nitrate of soda has increased the yield to a paying extent. This is the third season in succession that nitrate of soda has given between 5 and 6 bushels per acre increase on this farm.

(4) Farm of D. Gillanders, Darfield (Malvern).

A wheat crop preceded the experimental sowings on this paddock, which had previously to that been in grass for four years. The dates of sowing the plots were 24th and 25th May, 1927.

As in the case of all the other experiments, no differences were visible just after the crop came through, but in early September the superphosphate and basic super plots showed a marked superiority in growth over the Nauru and Ephos plots, which themselves were quite superior to the no-manure plots. The differences persisted until just before the crops came into ear, and after this differences were hard to detect. In Experiment B the delayed growth on the plots receiving potash was very marked, but counts revealed no difference in the actual number of seeds germinating. About three weeks after the application of nitrate of soda, on 29th September, its effect was much in evidence, and a marked superiority continued to the end of the growing-period. Tables 4A and 4B indicate the results.

Table 4A.

(Each yield is the average of 26 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) No manure	40·2	..	..
(2) Superphosphate	45·1	**4·9**	Profit, 18s. 9d.
(3) Basic super	42·8	**2·6**	Profit, 7s. 9d.
(4) Ephos phosphate	42·7	**2·5**	Profit, 6s.
(5) Nauru phosphate	43·4	**3·2**	Profit, 10s. 6d.

Comments on Table 4A: All treatments show a paying increase over no-manure. Super has proved the most paying form of phos-

phate, and has given a highly significant increase over the other three phosphates.

Table 4B.

(Each yield is the average of 22 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	45·4	..	Profit, 18s. 9d.
(2) Super plus potash	47·1	1·7	Profit, 11s. 3d.
(3) Super plus nitrate of soda ..	54·5	9·1	Profit, £2 6s. 3d.
(4) Super plus potash plus nitrate of soda	51·3	5·9	Profit, 15s. 3d.

Comments on Table 4B: Although potash added to super has caused an increase of 1·7 bushels over the super yield, it has not proved paying, reducing the net profit to 11s. 3d. per acre. The super and nitrate-of-soda combination has proved greatly superior to super alone, with a resultant net profit of £2 6s. 3d. per acre. Treatment 4, while showing a considerable increase over super, has not yielded as well as treatment 3. The difference between treatment 3 and treatment 4 of 3·2 bushels is highly significant. This reduction in yield to below the super-plus-nitrogen yield when the potash is used in conjunction with super and nitrate of soda is difficult to account for, and as the same thing has occurred in several other experiments this season a further note is made on it later (page 349).

(5) Farm of J. McAnulty, Methven (Malvern).

The area selected for this experiment was in a paddock which had been in grass for six years before. The plots were drilled on 10th and 11th June, 1927, and harvested on 13th February, 1928.

At no stage in growth did the plots in Experiment A show any marked differences, although a careful examination revealed a slightly better growth on the super and basic super plots from September to December. On Experiment B the plots were very uniform in growth—there being no adverse effect from potash—until three weeks after the application of nitrate of soda, when a distinct though slight effect was in evidence. The nitrate was applied on 27th September. Yields are given in Tables 5A and 5B.

Table 5A.

(Each yield is the average of 22 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) No manure	67·7	..	..
(2) Superphosphate	74·9	7·2	Profit, £1 10s. 3d.
(3) Basic super	75·0	7·3	Profit, £1 11s. 3d.
(4) Ephos phosphate	71·3	3·6	Profit, 11s. 6d.
(5) Nauru phosphate	68·3	N.S.	Loss, 5s. 6d.

Comments on Table 5A: Super and basic super have each given practically equal and highly-paying increases over no-manure to the extent of more than 7 bushels. Nauru phosphate has failed to establish a significant increase in yield. Both super and basic super are significantly better than Ephos and Nauru.

Table 5B.

(Each yield is the average of 20 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	68·8	..	Profit, £1 10s. 3d.
(2) Super plus potash	69·7	N.S.	Profit, 14s. 3d.
(3) Super plus nitrate of soda ..	74·2	**5·4**	Profit, £1 19s. 3d.
(4) Super plus potash plus nitrate of soda	73·2	**4·4**	Profit, 18s. 3d.

Comments on Table 5B: No significance can be attached to the slight increase of super plus potash over the super alone, and the use of the potash must be regarded as a loss, thereby reducing the net profit to 14s. 3d. per acre. The increase due to nitrate of soda of nearly 5½ bushels per acre is quite a paying one, and the net profit of £1 19s. 3d. per acre is quite handsome. The failure of potash in the fourth treatment again reduces the profit.

(6) Farm of J. Topham, Arowhenua (Geraldine).

The crops preceding the wheat experimental plots were potatoes, white clover, and wheat. The plots were sown on 13th and 14th July, 1927, and harvested on 17th February, 1928. The crop looked remarkably well throughout, and in Experiment A there appeared to be a slight stimulation in growth on the super and basic super plots. In Experiment B the nitrate was applied on 29th September, but no appreciable effect could be detected. The results are given in Tables 6A and 6B.

Table 6A.

(Each yield is the average of 21 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) No manure	59·7	..	..
(2) Superphosphate	60·2	N.S.	Loss, 5s. 9d.
(3) Basic super	60·1	N.S.	Loss, 5s. 3d.
(4) Ephos phosphate	59·7	N.S.	Loss, 6s. 6d.
(5) Nauru phosphate	59·3	N.S.	Loss, 5s. 6d.

Comments on Table 6A: None of the manures has caused a significant increase in yield over no-manure.

Table 6B.

(Each yield is the average of 26 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	61·3	..	Loss, 5s. 9d.
(2) Super plus potash	62·9	**1·6**	Loss, 13s. 9d.
(3) Super plus nitrate of soda ..	65·6	**4·3**	Loss, 2s. 3d.
(4) Super plus potash plus nitrate of soda	63·7	**2·4**	Loss, £1 7s. 9d.

Comments on Table 6B: All treatments (2, 3, and 4) show better yields than super, but, with the exception of treatment 3, the losses are greater than that when super alone was used. It should be noted that the nitrate-of-soda increase of 4·3 bushels is worth £1 1s. 6d., which is more than sufficient to pay for 18s. worth. Hence the loss is occasioned by the super. Of course, it is not certain that the nitrate alone would have given so big an increase. Potash and nitrate as single additions to the super (treatments 2 and 3) give increases, but potash used in conjunction with super and the nitrate (treatment 4) has not been beneficial. The difference between Plots 3 and 4 is significant. The similarity to Table 4B should be noted.

(7) Farm of J. Patrick, Willowbridge (Waimate).

On this farm Experiment A followed rape in the rotation, and Experiment B followed wheat on the same paddock, which had previously been in barley and green feed (oats). Unfortunately, the crop in Experiment A lodged so badly as to preclude the possibility of cutting the plots, and the experiment had to be abandoned. At no stage during growth could differences be detected. On Experiment B the potash plots displayed a little of the delayed growth typical of most of the northern experiments. The nitrate of soda was applied on 6th September, with no perceptible later effects. As Experiment A had to be abandoned, information regarding phosphates is not available, and no profit or loss is shown against super in Experiment B.

Table 7B.

(Each yield is the average of 22 plots.)

Treatment.	Bushels per Acre.		Net Profit or Loss per Acre.
	Yield.	Difference.	
(1) Superphosphate	38·4	..	..
(2) Super plus potash	37·2	N.S.	Loss, 16s.
(3) Super plus nitrate of soda ..	37·6	N.S.	Loss, 18s.
(4) Super plus potash plus nitrate of soda	40·9	**2·5**	Loss, £1 1s. 6d.

Comments on Table 7B: This table presents an interesting state of affairs. All additions to the phosphates have shown a loss, and

although potash and nitrogen individually added to super (treatments 2 and 3) show no increase, when all three are applied a definite and significant increase is registered. This, however, is far from being paying.

General Remarks and Summary.

The season was particularly favourable for wheat-growing, with, generally speaking, ample rainfall without any very serious overwet periods. The large yields evidence the excellence of the season.

PHOSPHATES.

Four out of the seven experiments show paying increases from the use of phosphates. Experiments 2, 6, and 7, where no phosphate response occurred, do not necessarily indicate that the districts in which these experiments were conducted are not responsive to phosphates. All that they tell us is that in the season of trial the areas selected did not respond. Further work in future seasons will enable a determination to be made of whether the present season's results are typical or not.

SUPERPHOSPHATE AND BASIC SUPER.

These did not differ significantly in Experiments 1 and 5 (Tables 1A and 5A), but super established a definite superiority over basic super in Experiments 3 and 4 (Tables 3A and 4A). Superphosphate proved superior to Ephos and Nauru in Experiments 3, 4, and 5, and though the difference is not statistically significant in Experiment 1 it points in the same direction.

It should be noted that, as in previous years, the greater the effect of phosphates in increasing yield the earlier the stage of ripening. Experience has shown that where phosphate-treated cereals ripen before untreated a sure indication of an increase from the phosphate is obtained, although it does not follow that there is no increase where maturity is not hastened from the use of phosphates. Unfortunately, however, most farmers view early maturity as what is commonly called "blighting-off."

NITRATE OF SODA.

The crops most likely to respond to spring application of soluble nitrogenous fertilizer are those showing the all-to-common light-green to yellowish-green colour.

In selecting areas for the experiment no attempt was made to select paddocks likely to specially respond to nitrogen, and it is surprising that such good response should have been obtained on some of these fields. It is highly improbable that the high nitrogen response is altogether due to the peculiarities of the season, because this is the third year in succession that an increase of between 5 bushels and 6 bushels per acre has occurred on Mr. Carpenter's farm at Prebbleton (see *Journal* for September, 1927, p. 187, and August, 1926, p. 111) as a result of using nitrogen in the spring.

In addition to the foregoing experiment, Mr. Kennedy, of Springbank, Mr. Spence, of Mitcham, and Mr. H. Wilkinson, of Chertsey, all on lighter wheat-land, used nitrate of soda on small plots at the

Department's request. On the two first-mentioned farmers' paddocks the response was remarkable, and must have been between 10 bushels and 15 bushels per acre. There was a definite response on the last-mentioned farm also, but the plot was not inspected just before harvesting, and no close estimate could be formed of the result. Next spring the Department intends to conduct a comprehensive further trial and demonstration of the use of soluble nitrogen as a spring top-dressing for cereals.

POTASH.

Considerable diversity of results occurred with the use of potash. In five of the experiments there was an early retardation of growth, and in two of them definite harm to germination to the extent of 15 to 17 per cent. took place. The effect on yield did not correspond with the early effect on growth. In one experiment (3B) potash caused a definite depression in yield to the extent of over 4 bushels per acre when used with superphosphate on the one hand and with super plus nitrate of soda on the other. In three experiments (2B, 4B, and 6B) potash added to super gave significant though non-paying increases. In all three nitrate of soda added to super gave paying increases, but potash in combination with super and nitrate of soda showed a considerably lower yield than super plus nitrate. Two of these latter were highly significant, and the third, though non-significant, was no doubt real enough.

The same order of things is apparent in Experiment 5B, although the potash-plus-super increase and the potash-plus-super-plus-nitrate decrease, as compared with super plus nitrate, are not significant. The writers can offer no reason for this behaviour of the manures. There is not sufficient evidence from these experiments to warrant the recommendation of the use of potash on wheat.

The valuable co-operation and assistance so willingly given by farmers is much appreciated, and the assistance of Messrs. Hardy, Elliott, and Leitch, of the Fields Division's staff, is duly acknowledged. The muriate of potash used in the experiments was kindly supplied free of charge by Dalgety and Co., Ltd., Christchurch.

Noxious-weeds Order.—The Peninsula County Council (Otago) has declared hemlock, burdock, gorse, and broom as noxious weeds, and Californian thistle as not a noxious weed, within that county.

The Ragwort Moth.—At the April meeting of the Council of Scientific and Industrial Research the Acting-Chairman stated that after extended trials it had been decided by the Noxious Weeds Committee that a restricted permit only should be issued for the release of the ragwort moth *Tyria jacobaeae*. It was considered necessary to take the utmost precautions regarding all insect releases; hence *Tyria jacobaeae* was placed out on ragwort areas in the immediate vicinity of the Cawthron Institute only. In the event of its ultimate safety being thoroughly proved, this action will render a large supply of insects available for more extended release next season. It is hoped that the outbreak of wilting-disease which has appeared, probably as a result of the restriction of the moths to a confined feeding-area, will not seriously diminish the number which will winter over and be available for release, if such a course is decided upon, at a later date.

MARTON EXPERIMENTAL AREA.

NOTES ON OPERATIONS, 1927–28 SEASON.

J. W. DEEM, Instructor in Agriculture, Wanganui.

THE autumn and winter of 1927 were very wet at Marton, and consequently difficult for agricultural operations, which had to be delayed until late spring. Work then had to be rushed, as the weather set in dry, and the heavy soil rapidly went hard and cracked. The rainfall recorded locally for the twelve months April, 1927, to March, 1928, inclusive, totalled 34·47 in., compared with 49·51 in. during the preceding year, and an average over twenty years of about 40 in.

Heavy rain in November (6·36 in.) gave both crops and pastures a great push, and carried them on well to Christmas, after which the district experienced the prevailing abnormally dry summer, with practically no growth.

CLOVERS AND GRASSES.

The various strains of white clover under experimentation continue to give interesting results. The imported Kentish wild white and the Canterbury (N.Z.) white have produced a wonderful sward, the whole area being pure clover, whereas the ordinary imported white adjoining, sown on the same day and under the same conditions, has nearly died out, the ground having become badly infested with grass, chiefly *Agrostis stolonifera* (water-couch or creeping-bent). While the Kentish and Canterbury clovers are both excellent, there is no doubt that the former is the superior; it appears to come away rather quicker, and also has a greater spreading habit. As in previous seasons, the Kentish clover has produced very few flowers.

In the red-clover trials Montgomeryshire Late Cut continues to give the best cover. It was hoped to get some seed this season, but owing to the extremely dry weather there was very little second growth, and only a small quantity was saved. This has lately been sown in another field. A further quantity of genuine Montgomeryshire seed has been received from Britain, and will be sown in a 10-acre field next spring for seed purposes. The New-Zealand-grown red clover is still doing well, but the ordinary imported red has practically died out, although only in its second year.

Trials between genuine Hawke's Bay old-pasture perennial rye-grass and South Island standard seed have been continued, and extended to include Sandon rye-grass. So far the superiority of the Hawke's Bay seed is very marked.

PALATABILITY AND PASTURE-MANAGEMENT.

In December, 1924, a field was sown in two strains of white clover, these being divided by a ½-chain strip of Phalaris bulbosa (perennial canary-grass). The whole area has been treated alike, simply grazed by sheep, and no top-dressing has been done. From the beginning the clovers were relished by the stock and kept in good order, while the phalaris area was neglected, with the result that rushes appeared on it. This development has afforded a noteworthy example of the

FIG. 1. ONE OF THE WHITE CLOVER TRIAL AREAS AT MARTON.

In foreground—plot sown in ordinary imported white, now almost run out and land infested with Agrostis stolonifera, in background—plots of Canterbury white and Kentish wild white in thriving condition.

FIG. 2. CLOSE-UP VIEW ON DIVIDING LINE OF CLOVER PLOTS SHOWN IN FIG. 1.

On left—run-out ordinary imported white; on right—Canterbury white.

[*Photos by H. Drake.*

FIG. 3. EXAMPLE OF EFFECT OF UNPALATABLE PASTURE.

In centre—strip sown in Phalaris bulbosa, neglected by stock and now rush-infested. To right and left — plots of white clover, well grazed and in good condition. *[Photo by H. Drake.*

incidence of palatability and the necessity for proper pasture-management. Fig. 3, reproduced from a photograph taken three years after sowing, gives a fair idea of the present state of the area. Prior to sowing in clovers and grasses in 1924 this piece of land had been under cultivation for several years, growing grain, fodder crops, peas, and roots, a root crop coming last.

PASTURE TOP-DRESSING.

The experiments referred to in last year's report (*Journal*, September, 1927) have been continued, and a further area, known as Follet's section, has been treated. This area is a continuation of the same type of land as that known as Brice's section, and has been down in grass for probably thirty years. The covering at time of treatment consisted almost entirely of Agrostis stolonifera and sedges. Particulars are given below (1) of trials on part of Field 4 between superphosphate and Seychelles "guano," and (2) of a test between the same phosphatic manures plus potash. It will be noted that the addition of the potash gave a slight increase over the phosphatic dressings alone. This is the first time that potash has given an increase at the Marton Area. All dressings were repeated several times, and the weighing carefully done on the approved method.

(1) Manure applied, 23/7/27; field closed, 15/9/27; material weighed, 5/12/27.
Superphosphate, 44/46 per cent., 3 cwt. per acre. Green material cut, 9·4 tons per acre.
Seychelles guano, 3 cwt. per acre. Green material, 9·13 tons per acre.

(2) Manure applied, 23/7/27; field closed, 15/9/27; material weighed, 5/12/27.
Super, 3 cwt. per acre. Green material, 9·73 tons per acre.
Super, 3 cwt., and muriate of potash, ½ cwt., per acre. Green material, 10·11 tons per acre.
Seychelles guano, 3 cwt. per acre. Green material 9·22 tons per acre.
Seychelles guano, 3 cwt., and muriate of potash, ½ cwt., per acre. Green material, 10·21 tons per acre.

Moss's Section, Field 4A.

This area was not top-dressed during the past season, but the plots were weighed to ascertain the lasting effects of the previous treatments. Table 1 gives the weights for the past season, for 1925 and 1926 combined, and for the total of the last three years. Interesting points are the good showing of basic slag, Nauru phosphate, and super, also super plus nitrate of soda. This latter area shows a wonderful recovery of cocksfoot and crested dogstail, while white clover is also doing well.

Table 1.

Plot No.	Treatment per Acre.	Grass Weight per Acre, 1927 Cut.	Grass Weight per Acre, 1925 and 1926 Cuts.	Total Weight per Acre, Three Cuts.
		Tons.	Tons.	Tons.
1	Carbonate of lime, ½ ton, applied 27/7/25	1·61	1·75	3·36
2	Control (no manure)	1·39	1·30	2·69
3	Carbonate of lime, ½ ton, 27/7/25; super, 3 cwt., 27/7/25, 28/5/26	3·97	6·10	10·07
4	Control	1·17	1·70	2·87
5	Super, 3 cwt., 27/7/25, 28/5/26 ..	4·62	4·90	9·52
6	Control	1·65	1·85	3·50
7	Basic super, 3 cwt., 27/7/25, 28/5/26	3·53	3·65	7·18
8	Control	1·96	1·50	3·46
9	Basic slag, 3 cwt., 27/7/25, 28/5/26 ..	4·75	5·85	10·60
10	Control	1·57	1·70	3·27
11	Nauru phosphate, 3 cwt., 27/7/25 ..	4·80	5·05	9·85
12	Control	2·14	1·90	4·04
13	Super and blood and bone (half-and-half), 3 cwt., 27/7/25, 28/5/26	3·62	3·70	7·32
14	Control	1·44	2·15	3·59
15	Super and blood and bone (half-and-half), 3 cwt., plus sulphate of potash, ¼ cwt.	4·75	4·40	9·15
16	Control	3·21	2·25	5·46
17	Super, 3 cwt., 27/7/25, 28/5/26, plus nitrate of soda, 1 cwt., 7/10/25, 13/10/26	6·15	7·18	13·33

The results of the addition of nitrate of soda to plot 17 suggested that nitrogenous manures should be further tested on this area. Accordingly strips ½ chain wide right across the phosphatic dressings were treated with nitrate of soda and sulphate of ammonia at the rate of 1 cwt. per acre. This was applied on 20th September, 1927, and the grass weighed on 29th December. Results were as follows:—

Average for sulphate of ammonia, 4·12 tons per acre. Increase, 1·41 tons.
Average for controls, 2·71 tons per acre.
Average for nitrate of soda, 3·43 tons per acre. Increase, 1·24 tons.
Average for controls, 2·19 tons per acre.

The increase in weight was due to stronger growth of rye-grass and dogstail.

Brice's Section, Field 3A.

This section was not top-dressed in the past season, but weighed again as usual. Table 2 is interesting as showing the building-up effects of the different fertilizers. It is not proposed to top-dress this area this season, but to weigh again next year and further test the lasting effect of the different fertilizers.

Table 2.

Plot No.	Treatment per Acre.	Green Weight per Acre, One Cut, 29/12/27.	Total Green Weight per Acre, Four Years, One Cut each Year.
		Tons.	Tons.
1	Carbonate of lime, 1 ton, 9/8/21; super, 2 cwt, 9/8/21, 11/8/24, 28/5/26	5·30	25·10
2	Bone-char, 4 cwt., 9/8/21; Nauru phosphate dust, 4 cwt., 11/8/24, 28/5/26	6·87	21·77
3	Walpole Island phosphate, 4 cwt., 9/8/21; Nauru phosphate, 4 cwt., 18/8/24, 28/5/26	7·33	21·63
4	Nauru phosphate, 4 cwt., 2/11/22, 11/8/24, 28/5/26	6·54	21·24
5	Control (no treatment)	1·56	5·12
6	Basic slag, 4 cwt., 14/7/21, 11/8/24, 28/5/26	5·19	18·05
7	Nauru phosphate, 4 cwt., 14/7/21, 11/8/24, 28/5/26	7·66	16·84
8	Ephos phosphate, 4 cwt., 14/7/21, 11/8/24, 28/5/26	7·86	18·66

Follet's Section.

This area was top-dressed for the first time on 30th July, 1927, all manures being applied at the rate of 3 cwt. per acre. Weighing was done on 29th December. A test was made between super, Seychelles guano, Nauru phosphate, and special Nauru. The latter consisted of the very fine dust collected at the crushing-works, and would be from 50 to 100 per cent. finer than the ordinary Nauru ground phosphate. This dust was used in order to ascertain whether extreme grinding was of any value with Nauru, and to check the results with those of a similar test made in the preceding year. There was also a test between superphosphate and sulfurophosphate. Results were as follows:—

	Green Weight per Acre. Tons.	Increase over Control. Tons.
Super, 44/46 per cent...	5·76	3·67
Ordinary Nauru phosphate	4·06	1·97
Nauru dust	3·66	1·57
Seychelles guano	4·89	2·80
Controls	2·09	..
Super, 44/46 per cent.	6·19	3·88
Sulfurophosphate	4·74	2·37
Controls	2·37	..

OTHER PASTURE WORK.

The small grass-plots have been extended to include, among other grasses, a further sowing of Phalaris stenoptera from seed received direct from California, and Paspalum compressum. The Phalaris germinated well, but so far no plant of the paspalum has been noticed. There is nothing outstanding among the small plots to record, except perhaps a special strain of Danish cocksfoot which appears to be forming a very fine sward.

A 5-acre field has just been sown in various grasses, in order to form a link in certain grass-research work being conducted by Mr. E. Bruce Levy, the Department's Agrostologist.

CEREAL CROPS.

These consisted of 12 acres of Black barley, autumn-sown, and 5 acres each of wheat and barley, spring-sown. The autumn-sown barley was almost drowned out, and the crop did so poorly that it was decided to eat it off with sheep, as it would not have paid to harvest. The spring crops were fair. The wheat—Jumbuck variety—was grown alongside a plantation and suffered severely from bird depredation right up to date of threshing. The Spratt-Archer barley was sown very late, but both it and the wheat were good samples. The barley has been secured by farmers for growing in the district next year.

It may be mentioned here that Jumbuck wheat was introduced into the Marton district through the Experimental Area. This season most of the wheat grown in the district was Jumbuck, and, besides giving record yields, it is considered by the local miller to be the best locally grown wheat as to flour that he has ever put through the mill.

SEEDS IMPORTATION REGULATIONS.

THE following regulations under the Seeds Importation Act, 1927—a summary of which measure was given in the *Journal* for December last—were gazetted on 28th April:—

1. (1) These regulations may be cited as "The Seeds Importation Regulations, 1928."

(2) These regulations shall come into force on the date of publication in the *Gazette*, but shall not apply to any seed that may then be in transit by sea to the Dominion.

(3) For the purposes of these regulations, unless the context otherwise requires, "the said Act" means the Seeds Importation Act, 1927; "import" includes attempting to import or being concerned in importing; "seed" means cocksfoot (*Dactylis glomerata*), lucerne (*Medicago sativa*), or white clover (*Trifolium repens*) seed, or any other seed declared by the Governor-General in Council to be subject to the provisions of the said Act; "Inspector" means any person appointed as Inspector for the purposes of the said Act.

2. (1) Not less than one per centum of each package of seed imported into New Zealand shall be stained prior to importation with a red colouring-matter.

(2) The colouring-matter to be used shall be either an alcoholic solution of saffranin or a specially prepared and effective fluid seed-staining dye.

(3) Staining shall be done by mixing one per centum of the bulk with the stain and then blending the stained parcel with the bulk lot.

3. (1) The form of certificate required by subsection (2) of section 5 of the said Act shall be in the form set out in the First Schedule.

(2) The certificate shall be in duplicate. One copy shall be retained by the importer at the port of entry, and the other shall be supplied by him to the Inspector, who shall, on being satisfied that the seed covered by the certificate has been treated as prescribed in these regulations, issue a permit in the form set out in the Second Schedule for the seed to be landed.

4. The following shall be the only ports of entry for seed: Auckland, Wellington, Lyttelton, Dunedin, Port Chalmers, Bluff.

The schedules may be seen in the *Gazette*.

Milk By-products.—The question of economical evaporation of whey and buttermilk is now being studied under the auspices of the Research Council. Arrangements are in hand for special investigations to be carried out at the New Zealand Co-operative Dairy Co.'s laboratory, Hamilton, and at the Hawera Dairy Laboratory.

SEASONAL NOTES.

THE FARM.

WINTER FEEDING OF DAIRY COWS.

INADEQUATE winter feeding of cows is a common cause of low production in dairy herds. A cow calving in good condition and properly fed after calving will quickly reach her maximum production, whereas one calving in poor condition takes some time to reach her maximum yield of milk, for instead of converting her feed into milk she at first uses it to regain condition lost during the winter. The fear of milk-fever is a common objection raised to having cows in good condition at calving time, and although an excess of fat does probably render a cow more liable to milk-fever, the safety-line is much higher than is generally imagined. It is probable that far more cows are lost through weakness than succumb to milk-fever through overcondition; poverty at calving-time has such a detrimental effect on production that it is worth while taking a few risks.

In arranging a system of feed provision supplementary to grass careful consideration should be paid to the respective requirements of the winter, the early spring, and the late summer and autumn. Adequate feeding in the winter and spring is most important if a long high-producing lactation period is to be obtained from the cows. Cows calving in poor condition may not reach their maximum production till November, and the loss of milk-yield in the early lactation months is not noticed, because of the gradual increase in production as the season advances. A drop in milk-yield in the summer is very noticeable, and summer supplementary feeding often receives more attention than winter and spring feeding. The requirements for supplementary feed for the winter and spring do not vary greatly from year to year, whereas the summer requirements are very variable. The provision of winter and spring supplementary feed should receive first attention.

In feeding dry cows in the winter it should be remembered that normally a cow's fodder consists of green pasture grass with a moisture content of about 70 per cent. Pasture hay contains only some 15 per cent. of water, while roots contain about 90 per cent. If cows in the winter are fed either hay alone or roots alone digestive troubles are bound to occur, and the ration of a cow should be balanced so that it contains both dry and watery foods, the normal ration being about 14 lb. of hay and 50 lb. to 60 lb. of mangolds. Cows when dry are satisfied with bulky foods having a wide nutritive ratio, whereas when in milk they require highly nutritious fodders with a narrow nutritive ratio. Economy of feed is obtained by wintering the cows on coarse fodders such as hay and roots, and saving as much as possible of the winter growth of grass for the spring when the cows calve. When feeding hay and roots the hay should be placed in the field first thing in the morning, and the animals should be allowed to eat part of their hay ration before the roots are thrown out for them. Eating half-frozen roots on an empty stomach is a frequent cause of digestive troubles.

The usual methods of winter-feed provision are—(1) hay alone, (2) hay and ensilage, (3) hay and roots, (4) roots alone. The feeding of hay alone or roots alone is not generally satisfactory, and the chief point for consideration is whether the dairy-farmer should keep his whole farm in grass and rely entirely on hay, grass ensilage, and permanent forage crops such as paspalum and lucerne, for supplementary feeding, or whether it is better economy to grow roots for winter feeding. The question is capable of no general solution, but must be considered in relation to the conditions obtaining on each individual farm. Roots for winter feeding have the advantage of a high yield per acre, and 1 acre of carefully cultivated roots will produce as much winter feed as the grass from 8 or 10 acres of pasture converted into ensilage. When heavy winter feeding is aimed at it is usually impossible to save sufficient hay and grass ensilage for winter and summer feeding without seriously reducing the amount of feed available for cows in the late spring and summer. Probably the best plan is to save grass ensilage for summer feeding and grow sufficient roots for adequate winter feeding.

PASTURE-MANAGEMENT.

Permanent pastures will greatly benefit by a heavy tripod harrowing in the winter. The tripods are very efficient in spreading hard droppings, tearing out moss, and aerating the surface soil. Unspread droppings cause a rank uneven growth which is rejected by stock, and weeds usually occupy the bare spaces left by unspread droppings.

Top-dressing work should be pushed ahead ; June is a good month for applying less soluble phosphatic fertilizers such as basic slag.

DRAINAGE.

June is a suitable month in which to finish the cleaning-out of all open drains, and to carry out any tile draining-work that may be necessary. Before starting to tile-drain a field the plan of the proposed drains should be carefully worked out. The main line of tiles should follow the line of natural drainage where water collects. Parallel system of drains is suited to flat-lying land with a gentle slope in one direction. Long parallel laterals give the least amount of double drainage. It is often convenient to have the laterals running parallel to the fence-lines and to the "finishes," in order to give supplementary surface drainage in the same direction. Lateral drains should enter the main drain at an acute angle, and should in no case enter the opposite sides of the main drain at the same point, but a few feet of space should always intervene so that the flow of water in the main drains will not be checked by the meeting of two opposing currents. With a poor fall the lateral drains should not be more than 10 chains long ; with a good fall—say, 4 in. per 100 ft.—they may be 15 chains. To efficiently drain very stiff clays the parallel drains may require to be 20 ft. apart ; on moderately heavy soils 30 ft. to 60 ft. apart. Should springs be discovered in any part of the field it will be found advantageous to remove their water by special drains distinct from the regular system and at a greater depth, so that none of the spring water may be permitted to diffuse itself through the soil.

Tile draining is very costly, and many of the benefits of thorough drainage can be obtained less expensively by mole drainage. A strong,

firm clay or loam, free from stones, offers the greatest facilities for mole drainage. It is essential that the subsoil be of even texture. The surface of the field need not of necessity be perfectly flat or even, for the mole plough may be raised or lowered to some extent to suit the irregularities of the surface, but it must admit of a moderate and fairly uniform fall being given throughout the entire length of each drain.

The mole plough consists essentially of a broad, flat coulter on the bottom of which is a pointed sock, and the mole which is attached to the bottom of the coulter behind the sock. The main drain is cut in the ordinary way on the lower side of the field, and is usually laid in pipes. The main should be 6 in. to 9 in. deeper than the mole drains, so as to facilitate the discharge of water into it. The lines of the drains are usually 15 ft. to 30 ft. apart, and if the field has been ploughed in lands the drains are usually cut up the "finishes." The drains are usually 2 ft. deep. When the main drain has been dug the mole is dropped into the open branch and drawn to the higher side of the field; when it reaches the end of the drain a pin is knocked out of one end of the coulter and the mole comes out of the ground. The plough is then drawn back to the lower side of the field and starts again at the next branch. A mole plough will make about four miles of drains per day. In suitable soils the drains will last from fifteen to twenty years.

—P. W. Smallfield, B.Ag., Instructor in Agriculture, Ruakura.

THE ORCHARD.

WINTER PRUNING.

Now that the rush of export work is finished, growers will be directing their attention to other operations in the orchard. As mentioned in last month's notes, it is advisable to have a general clean-up of the packing-shed, grading-machine, &c., before starting on the winter work proper.

Probably the most important winter operation is pruning, and it is as well to get on with this as soon as possible. Many growers leave the pruning until winter is well advanced, and then have to rush the work to get it finished before the trees start into growth in the spring, with the result that many trees are simply cut—the skill, care, and judgment required for pruning not being given. Pruning is an operation that should not be entered upon lightly, so much depending on it for the future welfare of the tree. The previous season's growth and cropping of the tree should be taken into consideration, and pruning done accordingly. Different varieties require different treatment, and it is only by constant observation during the growing season, and acting accordingly, that success can be attained. It must also be remembered that individual trees of the same variety in the orchard call for special attention and treatment.

Although one of the principal objects of pruning is the production of high-class fruit, there are other factors to be considered. It is often noticed that some trees are producing heavily while very little growth is being made. In such cases the pruner must direct his attention to restoring the natural balance between growth and bearing,

otherwise in a very short time both the quality and size of the fruit produced will be seriously affected. Another factor is the building-up of a tree in such a manner that when the time arrives for fruit-production the trees will be sufficiently sturdy to carry their crops equally dispersed throughout the frame without fear of breakages. If this is done the use of props, wires, strings, &c., will not be necessary. The treatment of laterals for the development of fruiting-wood, the elimination of branches not conveniently placed, the amount of fruiting-wood in comparison with the annual growth made, the keeping of the tree reasonably open, the thinning of fruit-spurs on heavily-bearing trees—all these points must be kept constantly in mind when pruning is being done.

It is generally recognized that in most cases light pruning is preferable to very heavy cutting, although there are exceptions when it is necessary to use the secateurs very freely. There are various systems and styles of pruning according to variety and locality, all having the same object in view—that is, the building-up of a sturdy tree capable of producing the maximum amount of fruit—and the pruner must decide, from his knowledge of local conditions, &c., which system he should adopt to get the best results.

Soil-conditions also play an important part in pruning, and no orchardist can expect the best results from his pruning unless his cultural operations are sufficiently good to ensure the trees receiving the necessary food and moisture when most required. Drainage, manuring, and soil-fertility must be well considered and appreciated before the full measure of success can be obtained from pruning.

Stone-fruits.

Stone-fruits are usually pruned before pip-fruits, owing to the fact that they start into growth earlier in the spring. To get the best results the trees must be kept in a healthy and vigorous growing condition. This will encourage the production of lateral growth, on which most of the fruit is borne.

Peaches and nectarines produce the best fruit on the previous season's growth, consequently this class of growth should be encouraged as much as possible. Heavy laterals, not required for fruit, should be cut back close to the buds at the base. From these buds new laterals will form, which will be the fruiting-wood for the following season. Retain the small laterals for fruit-production, after which cut out at the base, making room for further laterals to develop. Keep the trees well open with equally-spaced leaders, cut out all dead wood, and induce the fruiting habit by careful production of lateral growth all through the tree.

Plums according to variety, whether Japanese or English, require slightly different treatment from the peach and nectarine. The Jap varieties are usually strong growers, and come to the fruiting-stage much quicker than English plums. Harder pruning can be done, especially on the leaders, while some of the laterals can be cut back to form spurs, on which good fruit is borne as well as on the previous season's growth. With the English varieties it is necessary to cut fairly hard in the early stages so as to produce a sturdy tree, after which light pruning is all that is necessary. The fruit is borne on spurs

developed from two-year-old wood and over. These spurs usually last for about four years and then die back. A constant supply may be obtained by treatment of the laterals each season.

Cherry-trees, like the English plum, require good cutting for the first season or two after planting. From this on very little pruning is required, only sufficient cutting being done to produce an average extension every season. If left unpruned cherry-trees will gradually become stunted, and the fruit produced will be of very inferior quality. The treatment of laterals and the formation of spurs should receive special attention, as it is on these that the best fruit is grown. Heavy cutting of branches is not recommended, as they often fail to respond, and gumming is the result.

Apricots in suitable districts are usually heavy growers, and require liberal pruning each season. The fruit is borne both on the previous season's growth and on spurs, and in the majority of cases laterals may be cut back to form extra spurs, or eliminated entirely if sufficient fruit-bearing wood is produced direct from the main branches. An exception must be made with the Roxburgh Red, the laterals of which are retained for fruit-production. In many instances the short fruiting-wood of the apricot dies back after two or three seasons. This can be partly remedied by cutting some of these growths to the collar at the base of the laterals every season, allowing the others to bear fruit and to be replaced the following year by new growths coming from the buds round the collar.

—G. Stratford, Orchard Instructor, Motueka.

Citrus-culture.

It is an outstanding fact this season that growth is late, abundant, and soft, resulting from the prolonged dry spell of weather followed by a late autumn favourable to growth. Such vegetative conditions render the trees much mo liable to frost injury than is the case with early-grown wood well-matured prior to the low-temperature season. Experience of past seasons has proved that adult trees, though temporarily checked and requiring the removal of much wood which has been killed by frost, are not permanently injured by the temperatures usually experienced, and make a good recovery during the succeeding summer. Practically the only safeguard which can be taken against frost damage to adult trees is to fill up all gaps in the shelter-belt, and deflect rather than encourage by ready passage the frost currents which usually sweep through such gaps. Later, in the event of tip-damage occurring, such damaged wood should not be immediately pruned away but left until danger from frost is over, during which time it will act as a protective covering and take the full force of succeeding low temperatures. With young trees the danger of permanent damage is more real, and trees subjected to low temperatures may be lost or damaged to such an extent as to be unable to recover full vigour. In situations where frost is to be expected some local protection, such as a wigwam of sacking or scrub, should be provided.

At this period trees should be sprayed with bordeaux, 4–4–40. This is advisable for several reasons, but is usually done to protect young and growing fruits from verrucosis and grey scab. Owing to the light set of fruit this season the spray may not be considered

necessary for this, but it is well to keep in mind the other virtues of early winter bordeaux, such as precaution against citrus brown-rot, a general hardening of foliage to help withstand frost, and a prevention of verrucosis on wood and foliage.

Ground work for the month will consist of keeping drains open to avoid stagnant water, and rough preparation of new land on which trees are to be planted later.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

CONDITION OF THE BREEDING-STOCK.

CONSIDERABLE judgment is required at this period of the year in regard to the feeding and general management of the different classes of stock, owing to the fact that provision of a similar ration to all birds in the flock would be a mistake. The food for the hens that are to occupy the breeding-pens in the coming season should be of a different character from that supplied to the laying pullets or even the hens which it is not intended to breed from—that is, if the breeding-birds are to be in a proper condition at the time of mating. The great aim should be to maintain the birds in a perfectly healthy state, but at the same time every care should be taken to see that they do not get into an overfat condition, as it is well known that good hatchable eggs and strong chicks cannot be produced from an overfat breeder. It is true that there is little danger of overfeeding the good layer with the right class of food when she is in laying condition, but this does not hold when she commences to moult and ceases to lay. Obviously, if she is provided with an abundance of rich stimulating food when not laying, and while there is no tax on her system for the formation of eggs, the formation of surplus fat has every encouragement. As already indicated, this should be avoided at all costs; the birds should be well fed but not overfed.

The aim should be to maintain the breeders in what may be termed a lean condition. To achieve this it will generally be found a wise policy to provide at all times a ration of hard grains such as wheat, oats, maize, &c., and as a rule the greater the variety of food provided the better will be the fertility of the eggs and the stronger the chicks. The grains should be fed in deep scratching-material, so that the birds are compelled to take a maximum of exercise in finding the grains. Reference is now chiefly made to cases where the birds are kept in confined quarters; where a good range is available, or, better still, a free range, nothing can take its place in providing healthy exercise and ideal conditions for breeding-stock. Usually hens during the moulting-period, and until they are nearing a laying-point, are disinclined to take exercise, and as a result when provided with an abundance of food, such as a mash mixture which is easily obtainable, they are encouraged to sit on the perches and grow fat. Thus in recommending a whole-grain ration fed in deep litter, it is with the object of keeping the birds busy as a means of preventing the storing-up of surplus fat. Particularly where a free range is available there is no

objection to giving the birds a light morning mash, so long as it is of a bulky nature. To give bulk to a ration consisting of pollard, bran, wheatmeal, &c., there is nothing better than well-cured finely chopped lucerne or clover hay. If scalded with boiling water and allowed to stand overnight this makes an ideal food for bulking the morning mash.

From now on, and indeed right through the breeding season, the birds should be frequently handled, and if there is any tendency for them to put on surplus fat the ration should be slightly reduced. They should also be encouraged to exercise as much as possible to prevent fat-accumulation. With birds that are being kept for egg-laying alone there is not the same objection to their getting into a more or less fat condition, for the reason that when nearing a laying-point they can be forced for egg-production, with the result that the amount of surplus fat will soon be reduced to a minimum. In the case of the breeding-hens, however, the matter is entirely different; it would be simply courting disaster to force a bird for eggs during the time it is producing these for the renewal of stock. I would again emphasize that if the breeding-hens are in an overfat condition, due to being provided with the wrong class of food or lack of exercise, not only will there be a high percentage of infertile eggs, but trouble will also be met with in the hatching and rearing of the chicks produced. The dead-in-shell trouble during the various stages of the incubation process is invariably due to a weak germ, and the weak germ traces back to the breeding-pen.

As is the case with all classes of stock on the plant, the breeding-hens cannot be oversupplied with greenstuff, while ample fresh water and grit are details which must not be overlooked.

A mistake often made is to endeavour to patch up for the breeding-pen a bird that has apparently recovered from some disorder It is always a risky matter, and the mistake, of course, is discovered when it is too late. A hen that has been affected with some trouble may recover sufficiently to more than pay for her keep, but such a bird is better kept out of the breeding-pen. The worst mistake that can be made in this connection is to use for the renewal of stock a male bird that has had its health impaired at any time. A weakness probably remains, and it therefore has not the stamina necessary to ensure the production of healthy offspring. I have seen many cases of weak stock which could not be successfully reared as a result of using doctored breeding-birds. To ensure the most satisfactory result there must be no question as to the constitutional vigour possessed by the parents.

FOWLS SLEEPING IN THE NESTS.

It is common for fowls, particularly when going through the moulting process, to acquire the habit of sleeping in the nests and not on the perches. No doubt the chief reason for this is that being incompletely feathered the birds feel the cold, and resort to the nests, which provide a warmer sleeping-place than the perches. It is a habit, however, which should be broken at the earliest possible moment, for the reason that it not only encourages the presence of insect pests, particularly the red mite, but also the eggs cannot be gathered in a clean state. The red mite—probably the worst enemy of domesticated fowls in this country—usually makes its first appearance on the

perches, or, of course, any other place where the birds rest by night. It is a simple matter to deal with the mite when its presence is confined to the perches, by having the ends of the latter arranged in such a way that they or the birds' feathers do not touch the walls of the house, and by giving the perches a frequent application of some kind of thick oil or grease to which is added some disinfectant or kerosene. Not so, however, when the mite gets a good foothold in the nesting-quarters, for from these they may soon spread to hiding-places in the walls, and when once this happens there is no telling when the pest will be stamped out.

Once birds take to sleeping in the nest the only practical way of breaking the habit is to place an obstruction in front so as to prevent them from entering. A board placed in front of the nests, or a piece of wire netting arranged in such a way as to be easily put up or taken down, will serve the purpose. The obstruction should be placed in position before roosting-time, and removed first thing in the morning to allow the birds to lay in the nests. Obviously some work is entailed in keeping the birds out of the nests by night, but in most cases this will prove a mere trifle compared with the labour of washing soiled eggs and cleaning up vermin-infested quarters.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

PREPARATIONS FOR WINTER.

As the off season is approached, and before the weather breaks for winter, it is essential to make the hives as snug as possible. New Zealand has its season which corresponds with the winter months in colder climates, when breeding almost ceases and food is scarce or entirely absent in the fields. Every effort should therefore be made to conserve the natural warmth of the bees. As indicated last month, mats are essential, and each hive should have at least two, and two spare ones, as occasionally dry mats are needed in exchange for damp ones. Good clean corn-sacks make the best mats. Cut the mats so that they exactly cover the frames, and on no account allow them to extend beyond the walls of the hive, or they will become wet and cause dampness, thus endangering the health of the bees.

REMOVAL OF SPARE SUPERS.

All supers not occupied by the bees should be removed preparatory to making the hives as snug as possible. A strong colony with a good queen at this time will need its brood-chamber and at least a super, and these will be fairly crowded with bees, most of them bred since the close of the working season. These are the colonies which one should strive to have at this season of the year, as they will come out strong in the spring and give the best returns when the main honey-flow sets in. As robber bees are likely to become troublesome when removing the supers, the best and safest plan is to use bee-escapes, for it will be found that quite a lot of bees must be got rid of before the supers can be removed. By placing the escapes on the hives in the evening the

supers will be clear of bees in the morning, providing there is no brood in the combs. If escapes are not used all hive-manipulations should be carried out expeditiously and as early in the day as is convenient.

SPARE COMBS.

In the absence of a proper comb-room, or any convenient place to store the combs to keep them clean from the wax-moth and vermin, they, with the supers, may be placed on the hives after confining the bees below with close-fitting mats. As a temporary means of protecting combs this plan serves the purpose. However, it is not a good one for preserving the combs for any length of time during the winter months, as there is a danger of the combs becoming mouldy. This will occur sooner or later in supers from which the bees are entirely shut out.

ANNUAL CONFERENCE.

The annual conference of the National Beekeepers' Association is to be held at Hawera on 29th and 30th June. The organizer of the South Taranaki Winter Show, which is to be held at the same time, is collaborating with the executive of the National to make the beekeepers' stay at Hawera enjoyable. Papers will be given by commercial beekeepers on subjects of interest. A comprehensive display of honey is being arranged at the winter show.

E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

PRUNING BUSH-FRUITS.

Suitable annual pruning of bush-fruits is as important as feeding and spraying, if they are to be kept in health and profit. On raspberry and loganberry brakes the fruiting-canes should have been cut out and burnt as soon as the crop was gathered, so that the young growth could be fed and sprayed to bring it into the best condition for next season's cropping. If this has not been done the old canes should now be cut out at the surface of the ground, removing also small thriftless growth. Train in the strong new growth for next season's crop, removing the short length of unripened wood at the tips.

Red and white currant bushes should be kept open to admit light and air. For that reason crowded growth should not be permitted, and where it occurs the superfluous growth should be removed completely. After this has been done, thin or shorten the small fruiting laterals on the permanent leaders as may be required, and top the leaders only if further extension is desired.

The black-currant brakes demand quite different treatment. These plants crop best with a denser growth and on young wood. For this reason the centre is not opened, but the old wood should be cut well back to a bud about its base and the young wood left without shortening the tops. This treatment, with the generous feeding this plant requires, will produce an abundant annual growth of young fruiting-wood. This valuable crop is best grown on moist well-drained soil in the cooler districts.

The gooseberry crop will be increased and more easily gathered if the bushes are pruned by opening the centres, removing the branches lying on the ground, and thinning out the remaining frame-work if it is crowded, as is so often the case. Finally shorten back old bearing-wood and the weak new growth to base buds. This leaves a good supply of medium-sized new wood, from which the unripened ends should be removed.

SEEDS AND POTATO SETS.

Potato sets are too often allowed to shrivel and sprout by being kept in a dark, dry position. If the quantity is small it is better now to spread them in trays and give them light and air. The short growth made under such circumstances is thrifty and sound, but where larger quantities have to be dealt with they should be given cool, light, humid conditions with no chance of heating. The practice of packing them in wide-jointed fruit-cases and stacking them in the shelter of trees in the open that is sometimes adopted is very suitable so long as they are not liable to be eaten and nibbled by vermin. If these stocks are not to hand they should be obtained without delay, as good sets are scarce. A certain quantity of certificated potato seed may now be obtained; this is an opportunity the keen grower should not miss.

In the purchase of garden seeds there are three points the commercial grower should carefully study, or he may give his time to a worthless object. The three points are quality, strain, and variety. Under the first heading come the considerations of germination and freedom from disease. It is important to ascertain the germination percentage, so that the drills can be properly adjusted when sowing. The work of thinning the seedlings may then be unnecessary in many instances, and certainly it will be lighter. The evidence regarding the danger of seeds carrying many kinds of fungous and bacterial diseases is now well established, and great care should be taken when harvesting or purchasing seeds to make sure, as far as possible, that they are free from disease. Remedial treatments for seed are now being worked out, and the danger from this source will no doubt be greatly lessened in the near future.

Seeds may be sound and of high percentage germination, but the habits of the plant may be thriftless. In the case of cabbage or lettuce it may easily bolt into seed-growth without heading, or celery may be hollow-stemmed, or tomato-plants may set few fruits or many small ones. While these troubles may be due to cultural methods or unseasonable weather, they are also often due to cheap seeds of poor strain. Bright strong seeds are very easily grown, but to maintain a high strain of seeds in annual and biennial plants demands a great deal of conscientious skill; but their value, however, will be readily appreciated by the experienced grower.

The guile of the seed catalogue is very fascinating to one who, if he has a little imagination, will be impressed with the descriptions of the various forms of plant perfection that are given. The catalogue-writer omits to state that all his fine promises are made under the condition of "weather and circumstances permitting." Of course, these statements are generally quite accurate as far as they go, but experience has taught that when transported to another country, or even district, varieties of high promise are sometimes disappointing—a literal

instance of circumstances altering cases. For that reason new varieties should be tested experimentally first, or the disappointment and loss may be great. There is another feature, however, about this that should not be missed: many a variety that has received an adverse verdict after trial has later come into considerable popularity; Kondine and Dreadnough tomatoes, for instance. What has happened, and what frequently happens, is that a variety after becoming acclimatized sometimes shows great improvement; or even the reverse may happen. For this reason it is well to be rather conservative in the matter of selecting plant varieties for main cropping. Small trials of new varieties from a good source, however, should be made, for they are sometimes of great value

TOMATOES AND CUCUMBERS UNDER GLASS.

Towards the end of June is the usual time for sowing the seeds of these crops, with a view to planting them in the glass-house towards the end of August. Use sterilized soil in the seed-boxes, and see that both the soil and water are sufficiently warm before use; they should be of the same temperature as the hot-bed on which the seeds are grown. Many of these crops are delayed, even if the plants are not seriously injured, by being chilled occasionally in the seed-beds. This danger is greatest where the temperature is sometimes allowed to run high. A temperature of 55° to 65° F., with dryish atmosphere, will give best results.

—*W. C. Hyde, Horticulturist, Wellington*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 22nd March to 3rd May, 1928, include the following of agricultural interest:—

No. 57050: Teat-cup claw; W. R. Cockburn, Otahuhu. No. 57169: Fencing-standard; H. W. Black, Manutuke. No. 58175: Teat-cup claw; T. Shiels, Wanganui. No. 58885: Dressing flax; A. J. Whiteside, Thames. Nos. 59489 and 59490: Teat-cup; International Harvester Co., Chicago, U.S.A. No. 59872: Tension-distributor for sheep-shears cutter; G. L. Stuart, Motueka. No. 56689: Plough-lift; T. M. Emerson, Te Ore Ore, Masterton. No. 58185: Harrow; A. Dale, Albury. No. 58252: Pasteurization of cream; T. Topliss, Greymouth. No. 58363: Centrifugal separation; Zeala Products, Ltd., Hawera. No. 58736: Cream-separator driving-means; W. Webb, Whangarei. No. 59010: Harrow; A. C. Sutherland, Whakatane. No. 60083: Distributing fertilizers; J. W. F. Lange and T. H. Varcoe, Mount Gambier, S. Australia. No. 60136: Pulsator for milking-machine; Aktiebolaget Separator, Stockholm, Sweden. No. 57780: Manufacture of condensed milk; L. R. Scammell, Adelaide, S. Australia. No. 57884: Teat-cup; W. Capil, Invercargill. No. 58242: Milking-machine; Warren Engineering Co., Ltd., Auckland. No. 58313: Milking-machine pulsator; A. B. Robertson, Hamilton. No. 5830: Teat-cup; Dr. Hutchinson, Kaponga. No. 59155: Mole drain-plough; A. A. Hawker, Hamilton. No. 5982: Evaporated milk; Borden Company, New York, U.S.A. No. 60130: Sheep-shears; Chicago Flexible Shaft Co., Chicago, U.S.A. No. 60159: Animal-trap; H. W. Tildesley, Willenhall, England.

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s. All fees must be paid in advance in cash, or paid to the Public Account at a branch of the Bank of New Zealand and the bank receipt sent to the Patent Office; or fees may be remitted by Post Office order or postal note.

WEATHER RECORDS: APRIL, 1928.

Dominion Meteorological Office.

GENERAL SUMMARY (ABRIDGED).

APRIL, on the whole, was a mild and humid month, with an absence of extreme temperatures. Although gales were recorded on several occasions, and that of the 30th was very severe, there were few drying winds. Rainfall was below normal over most of Taranaki and parts of the Manawatu, Hawke's Bay, and North Canterbury districts, but elsewhere there was an excess, which in most cases was considerable. Large areas in Nelson, Marlborough, Westland, South Canterbury, and North and Central Otago received more than double the average fall.

The central provinces experienced heavy falls in the wet spell which occurred during the Easter holidays. This was a particularly beneficial rain, since it was accompanied by very mild temperatures. It extended over several days, and in the early stages was light but steady; the ground, therefore, became thoroughly soaked, but the maximum of good and minimum of damage was done. Complete relief was given from the very dry conditions which had prevailed for the greater part of the interval since the end of December in Nelson and to a less extent in other districts. In other parts of the Dominion the heaviest rains were generally recorded in connection with the stormy period which commenced on the 25th and culminated on the 30th.

Sunshine was below the average, and cloudiness and humidity above. Mean temperatures were two or three degrees above normal at most places. Damaging frosts occurred in some parts of the South Island on the 5th and the 22nd. Gales were experienced over wide areas on the 4th, 12th, 14th, 16th, 21st, and 30th. None of these, however, was a westerly gale, and consequently, as mentioned above, none of them had any great desiccating effect. Much misty weather, with fog in many places, was experienced in connection with the several cyclones which controlled our weather at intervals during the month.

RAINFALL FOR APRIL, 1928, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall	Average April Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kataia	5·58	14	1·60	3·55
2	Russell	6·15	14	2·20	3·59
3	Whangarei	7·83	13	2·73	4·45
4	Auckland	4·90	21	1·69	3·46
5	Hamilton	5·94	15	3·06	3·86
6	Kawhia	4·98	13	2·84	4·64
7	New Plymouth	4·19	14	1·17	4·51
8	Riversdale, Inglewood ..	7·20	15	1·51	8·39
9	Whangamomona	5·95	9	1·24	6·62
10	Eltham	3·09	14	1·27	5·16
11	Tairua	7·36	9	4·80	6·33
12	Tauranga	5·14	8	2·89	5·08
13	Maraehako Station, Opotiki	4·02	10	2·48	4·57
14	Gisborne	2·28	10	1·61	4·20
15	Taupo	4·57	9	2·19	3·77
16	Napier	0·91	7	0·34	2·92
17	Maraekako Station, Hastings	2·67	9	2·05	3·14
18	Taihape	2·10	16	0·71	3·15
19	Masterton	5·39	12	1·68	3·04
20	Patea	2·17	11	0·43	3·59
21	Wanganui	2·64	10	0·85	3·37
22	Foxton	3·52	5	1·10	2·47
23	Wellington (Karori Reservoir)	6·03	12	1·70	3·80

RAINFALL FOR APRIL, 1928—*continued.*

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
		South Island.			
		Inches.		Inches.	Inches.
24	Westport	14·08	28	5·80	6·50
25	Greymouth	14·24	26	1·75	8·37
26	Hokitika	16·76	23	2·32	9·38
27	Ross	20·78	15	3·26	12·55
28	Arthur's Pass	28·72	18	6·96	16·16
29	Okuru, Westland	42·62	16	6·50	13·67
30	Collingwood	18·20	17	4·38	8·07
31	Nelson	7·34	13	2·15	2·93
32	Spring Creek, Blenheim ..	3·68	9	1·65	1·72
33	Tophouse	9·42	17	2·35	4·22
34	Hanmer Springs	1·76	15	0·48	2·99
35	Highfield, Waiau	0·90	6	0·30	2·66
36	Gore Bay	2·12	10	0·53	1·77
37	Christchurch	1·24	12	0·71	1·97
38	Timaru	3·74	14	0·76	1·51
39	Lambrook Station, Fairlie ..	3·41	13	0·58	1·95
40	Benmore Station, Clearburn	7·28	16	1·70	2·55
41	Oamaru	3·88	12	0·75	1·78
42	Queenstown	6·05	14	1·17	3·00
43	Clyde	2·80	12	0·62	1·34
44	Dunedin	4·35	16	0·80	2·82
45	Wendon	4·58	13	1·32	3·16
46	Gore	5·86	16	1·20	3·15
47	Invercargill	4·99	18	1·00	4·36
48	Puysegur Point	11·81	20	4·02	7·98
49	Half-moon Bay, Stewart Is.	5·49	16	1·26	5·29

WHEAT AND OATS THRESHINGS.

TABULATED below are returns of actual threshings received by the Census and Statistics Office up to 19th April from threshing-mill owners, and covering the months of January, February, and March, 1928:—

Land District.	Wheat.		Oats.	
	Quantity threshed.	Average Yield per Acre.	Quantity threshed.	Average Yield per Acre
	Bushels.	Bushels.	Bushels.	Bushels.
North Auckland ..	..	..	..	..
Auckland	311	18·29	..	..
Gisborne	1,947	26·31	304	30·40
Hawke's Bay	10,634	34·75	10,567	34·65
Taranaki	..	..	..	..
Wellington	58,392	35·78	29,477	42·23
Nelson	21,085	28·04	7,756	30·42
Marlborough	62,507	29·35	28,608	32·36
Canterbury	3,465,209	40·04	1,209,825	44·56
Otago	497,700	36·01	299,519	47·99
Southland	53,166	34·93	329,844	47·32
Dominion totals and averages	4,170,951	39·05	1,915,900	45·06

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

LOSS OF LAMBS.

C. and Co., Spring Creek :—

We have lost quite a number of lambs this year on our second feed-off of rape and on stubble. The symptoms are—dopy, excessive scouring, at times a desire for water, and after a few days death. There is no cough ; we have opened several lambs and can find no trace of lung or stomach worms. We have examined the paddocks thoroughly where the deaths have occurred, and can find nothing harmful except a prolific growth of deadly nightshade, which came up after the rain in February. Would this, if eaten, cause the deaths, and are the symptoms described those that are brought on by eating the nightshade ? Also, is the plant more poisonous at one particular stage of its growth ? Any information you can give on the subject will be appreciated.

The Live-stock Division :—

The symptoms described by you do not coincide with poisoning by the plant mentioned ; moreover, it is probable that the plant is not deadly nightshade but the black or common nightshade (*Solanum nigrum*). There is no evidence recorded of poisoning by the latter. It is highly probable from the history and the symptoms described that the cause of the mortality was internal parasites, especially the stomach-worm. It is at times difficult to demonstrate these parasites on post-mortem if the animal has been dead for some time before the post-mortem is held, hence their presence may have been overlooked. It may even be necessary on occasions to take a scraping from the mucous membrane of the stomach and have it examined under a microscope. When examining for parasites it is advisable to kill an affected animal and examine the contents of the stomach or bowels when fresh.

BOULDER DRAINS.

E. A. M. Lys, Mangatoro :—

I intend constructing some drains of boulders, and will be grateful if you will inform me on the following points : (1) Minimum size the boulders should be ; (2) depth of boulders required ; (3) how boulders should be arranged in trench ; (4) whether it would be any advantage to dig a V-shaped trench to receive boulders rather than a U-shaped one ; (5) whether it is necessary to put any covering, such as manuka, over boulders before covering with earth ; (6) fall required.

The Fields Division :—

Your inquiry can be answered only in a general way, for so much depends upon circumstances. For instance, if the boulders have to be carted any considerable distance their bulk and weight make the cartage expensive. In the first place, a much larger excavation is needed with boulders than with pipes, and there is no advantage in digging a V-shaped trench. Stones which would pass through a 2½ in. to 3 in. ring have been used with success. Larger stones, especially if flattish, can be used more effectively if set up in triangular or square form so as to leave a passage for the water. Above these larger stones can well be packed smaller ones decreasing in size as they approach the top of the drain. Within reasonable limits, the greater the depth of boulders the better the drain, but this will also be determined by the depth to which one can make the excavation and the quantity of boulders within easy distance of the drain. The use of manuka as a covering is to be recommended, provided it can be obtained without unreasonable cost or labour. If manuka cannot be used, the top layer of turf should be set aside when making the excavation, and should be carefully placed over the boulders in the drain before the filling in of the earth is commenced. Care should be taken to see that the boulders, and any covering such as manuka

placed above them, are deep enough to be undisturbed by any cultivation operations. A fall of 1 in 250 at least is desirable, but if circumstances compel somewhat less will do. Avoid changing from a given fall to a lesser one, otherwise the drains are likely to become blocked quickly. It is well to remember that generally stone drains do not allow the water to flow freely, favour the deposition of salt, and are liable to get out of place.

AFRICAN BOXTHORN FOR CENTRAL HAWKE'S BAY.

"INQUIRER," Otane :—

Please inform me whether African boxthorn is quick-growing, and if it needs to be protected from stock for long. What is the best method and time for planting, and would it do well in the Otane district ?

The Horticulture Division :—

On well-drained soil in the Otane district the African boxthorn would undoubtedly do well. Plant it any time during the winter when the land is reasonably dry and friable, placing the plants at their usual depth in the ground and firming them well. For long lengths a suitable method would be to chip and clean a strip of land about 1 ft. wide on each side of a wire fence. This should be well done in good weather. Then plant the shrubs a foot or two apart, close up to the wires and on the same side of them as the posts. They should not then require further protection. Give the hedge close attention for a year or two, and the boxthorn should be as quick-growing as most hedge-plants.

UNDEVELOPED UDDER-QUARTERS IN HEIFER.

"INQUIRER," Havelock North :—

I have a Jersey heifer coming in at two years old which appears to be developing only two quarters. I also had one last year which only developed one quarter. They were no relation to each other. Could you suggest any cause; also, could anything be done to avoid the trouble ?

The Live-stock Division :—

As only two quarters of the udder appear to be developing, daily massage for the two weak ones is suggested. Unless there is an inherited weakness in the strain, or total absence of mammary tissue in the two weak quarters, the latter will develop normally as the heifer approaches parturition. The defect you mention is not common, and may result from inbreeding where sufficient attention is not paid to that most important organ the mammary gland. In regard to prevention, it is advisable to very carefully examine the undeveloped mammary glands of all young heifers before service. If all four quarters are then apparently normal the animals may be put to service.

FORTHCOMING WINTER SHOWS.

Waikato Winter Show Association: Hamilton, 29th May to 5th June.
Otago A. and P. Society: Dunedin, 2nd to 7th June.
Poverty Bay Winter Show Association: Gisborne, 6th to 9th June.
Taranaki Metropolitan Agriculture Society: New Plymouth, 12th to 15th June.
Manawatu A. and P. Association: Palmerston North, 19th to 23rd June.
South Taranaki Winter Show Company: Hawera, 27th June to 4th July.
Auckland Winter Show Association: Auckland, 11th to 21st July.
Canterbury A. and P. Association: Christchurch, 4th to 18th August.

Eggs and Egg-pulp in Cold Storage.—At 31st March last the following quantities were in storage in the Dominion: Eggs in shell, 59,181 doz.; egg-pulp, 835,097 lb.; frozen whites, 1,360 lb.; egg-yolk, 500 lb.